INTERNATIONAL CONFERENCE

ON

INTERDISCIPLINARY APPROACHES IN CIVIL ENGINEERING FOR SUSTAINABLE DEVELOPMENT (IACESD-2023)

Publishing Partner

Springer

SPRINGER NATURE

Organized by:

JYOTHY INSTITUTE OF TECHNOLOGY

(Approved by AICTE, Affiliated to VTU)

DEPARTMENT OF CIVIL ENGINEERING

Accredited by National Board of Accreditation (NBA)

FOUNDER VISION AND MISSION

Kumari Jyothy

Dr. B N V Subrahmanya

VISION

To be an institution of excellence in engineering education, innovation and research, and work towards evolving great leaders for the country, meeting global needs

MISSION

The Institution aims at providing a vibrant, intellectually and emotionally rich teaching learning environment with the State of the Art Infrastructure and recognizing and nurturing the potential of each individual to evolve into ones own self and contribute to the welfare of all.

MESSAGE

Smt. B V Seetha
Chair Person
Jyothy Charitable Trust

I am very pleased that Jyothy Institute of Technology is organising the International Conference on Interdisciplinary Approaches in Civil Engineering for Sustainable Development (IACESD-2023) which will be held on 7th and 8th July 2023. The Conference has given an insight into the emerging trends in Civil Engineering, which will enhance the knowledge and research interests among the research community.

I congratulate the IACESD-2023 team for their sustained effort in bringing out this conference and wish them the very best.

MESSAGE

Dr. Gopalakrishna K

Principal

Jyothy Institute of Technology

Cradled in the lap of technology on the one hand and innovation on the other, swaying from serious thinking to playful inventiveness, students and staff at Jyothy Institute of Technology are brimming with a zeal for life, empowering themselves with skills and creativity.

I congratulate the professors, research scholars and students of various organizations who presented their ideas and research findings in the form of research paper. As long as our ideas are expressed and thoughts kindled, we can be sure of learning. I congratulate every author who are participating in the International Conference on Interdisciplinary Approaches in Civil Engineering for Sustainable Development (IACESD-2023) which will be held on 7th and 8th July 2023.

I am also very happy to note that this time a new section on Emerging Technologies is the icing on the cake. This will help research scholars to portray their skills in the advanced and productive technology in various fields of Civil Engineering. I thank our Management, Director and CEO for their constant encouragement and support. I also thank the Editorial Board for their mammoth contribution in preparing this conference proceedings.

MESSAGE

Prof. N. Vinod Chandra Menon

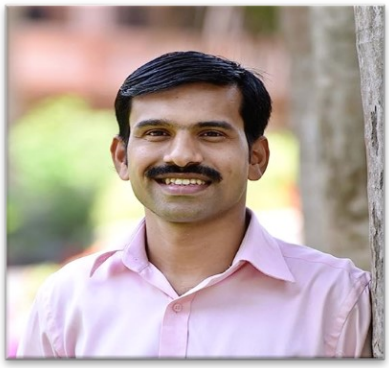
Founder Member, National Disaster Management Authority (NDMA). Government of India & International Coordinator, C20 Working Group on Sustainable and Resilient Communities: Climate, Environment & Net Zero Targets

Hon. Chairman, IACESD-2023

It is a great pleasure, on behalf of the Organizing Committee, to welcome the distinguished Key Note Speakers, eminent academicians and domain experts presenting selected papers and delegates attending the International Conference on Interdisciplinary Approaches in Civil Engineering for Sustainable Development (IACESD-2023) being organised by the Department of Civil Engineering, Jyothy Institute of Technology, Bengaluru during 7th and 8th July 2023 at the JIT Campus, Bengaluru. The host institution Jyothy Institute of Technology (JIT) was established in 2011 by the Karnataka Rajyothsava Award laureate Dharmika Pravara Late Dr. B.N.V. Subrahmanya whose visionary leadership as an institution builder has helped JIT to emerge as one of the leading engineering institutions in India. JIT conducts Under Graduate Programs and Post Graduate Programs in several engineering. An Atal Incubation Centre-Jyothy Institute of Technology Foundation (AIC-JITF) supported by Atal Innovation Mission, NITI Aayog, Government of India and a Centre for Incubation, Innovation, Research and Consultancy (CIIRC) supported by Sri Sharadha Peetham, Sringeri along with Jyothy Institute of Technology (JIT) and an Innovation and Entrepreneurship Development Centre (IEDC) established by JIT have been functioning to promote frugal innovations through mentoring and provision of an enabling environment.

IACESD 2023 received overwhelming response from domain experts from India and abroad and we are grateful to the support of CIIRC, KSCST, ICI, IGBC, VTU, Amrita Vishwa Vidyapeetham, ISTE and the Civil Society Platform C20 during India's G20 Presidency in 2023. I am also grateful to Smt. B.V. Seetha, Chairperson, Jyothy Charitable Trust (JCT) and Dr. S. Vidyashankar, Vice Chancellor, Visvesvaraya Technological University, Belagavi, the Chief Patrons of IACESD-2023 for their valuable guidance and encouragement. I extend a heartfelt thanks to the Patrons, Advisory Committee Members from Academia and Research Institutes and Industry, the Members of the Organizing Committee (Organization & Logistics), Members of the Technical Expert Committee, Dr. Sreekeshava K.S, Head, Department of Civil Engineering, JIT and Organizing Chair, IACESD-2023 and Dr. Sreevalsa Kolathayar, Assistant Professor, National Institute of Technology Karnataka (NITK), Suratkal and Technical Program Chair IACESD-2023 for all their sincere efforts in organizing this International Conference and look forward to a very successful learning experience during IACESD-2023.

MESSAGE



Dr. Sreevalsa Kolathayar
Assistant Professor,
Department of Civil Engineering
National Institute of Technology - Karnataka, Surathkal
Technical Program Chair, IACESD 2023

I am very happy that Jyothy Institute of Technology is hosting the G20 C20 International Conference on Interdisciplinary Approaches in Civil Engineering for Sustainable Development (IACESD-2023) under the Chairmanship of Dr. Vinod Chandra Menon during 7-8 July 2023 in Bengaluru. IACESD-2023 is a unique international conference that focuses on innovative approaches for sustainable infrastructure and highlights the role of civil engineering in sustainable development. With India's G20 presidency for the year 2023, this is the first of its kind conference under the banner of G20 C20 through its Working Group on Sustainable & Resilient Communities: Climate, Environment & Net Zero Targets. The main theme of the conference is "Civil Engineering Innovations for Sustainable Communities with Net Zero Targets". The conference aligns its agenda with the UN Sendai Framework for DRR and UN Sustainable Development Goals SDG6, SDG9, SDG11 and SDG13 which relate to clean water, infrastructure innovations, sustainable cities and climate action.

The conference aims to serve as a platform for researchers to meet, present, and discuss their research findings and innovative ideas to make the world better through sustainable development. IACESD-2023 is designed as a hybrid conference, with delegates from around the world participating either in-person or online, thus making the conference accessible to everyone. The conference program includes 20 keynote lectures from eminent academicians, scientists and practicing engineers. We have received over 800 abstracts. After a rigorous peer review, about 400 papers were accepted. The different themes of the conference include Building Materials & Technologies, Structural Engineering, Environmental Engineering, Applications of IoT, ML & AI in CE, Geotechnical Engineering & Pavement, Traffic & Urban Planning, GIS & Remote Sensing, Irrigation & Water Resources Engineering, Climate Change & Net Zero Targets, and Natural Hazards. Springer has kindly agreed to publish the conference proceedings. The Proceedings volumes will contain invited articles and contributory papers that align with the United Nations Sustainable Development Goals. Due to its broad appeal with focus on technology and alignment with important global initiatives, the conference is expected to attract a significant number of delegates from both India and abroad.

MESSAGE

Dr. Sreekeshava K S
Associate Professor & Head,
Dept. of Civil Engineering & Structural Engineering, JIT
Organizing Chair, IACESD-2023

The two-day G20 C20 International Conference on Interdisciplinary Approaches in Civil Engineering for Sustainable Development (IACESD-2023) provides a platform to the researchers, faculty and practitioners to showcase their ideas and innovations related to Sustainable Development. It gives me an immense pleasure to extend a warm welcome to all the participants to the IACESD-2023.

The guidance and encouragement provided by Smt. B V Seetha, Chairperson, Jyothy Charitable Trust and the management of Jyothy Institute of Technology has motivated the organizing team to strive for excellence and create an enriching experience. The unwavering support and encouragement provided by Dr. Krishna Venkatesh, Director, CIIRC and Dr.K Gopalakrishna, Principal of Jyothy Institute of Technology have been pivotal in creating an environment conducive to excellence and knowledge exchange.

I would like to express our sincerest gratitude to the G20 and C20 organizations for granting us the privilege to host such a significant event. The scholarly insights and profound knowledge provided by Prof. N Vinod Chandra Menon have greatly enriched the content and discussions during the conference preparation. The expertise and guidance provided by Dr. Sreevalsa Kolathayar have been instrumental in ensuring the smooth organization of the conference. His inputs and advice have helped us navigate challenges, make informed decisions and deliver a seamless event. I am immensely grateful for his valuable contributions.

I thank the team of Springer Nature for accepting to be the publishing partner for the proceedings and also for awarding the best paper presentation in each category of the conference.

I extend heartfelt thanks for DK constructions, SLN Infra, Sundaram Architects & Ameen Indane for their valuable support and sponsorship.

The success of the conference could not have been achieved without the unwavering commitment and dedication of the faculties, technical staff and office staff whose collective efforts have played an instrumental role in making this event a resounding triumph. Involvement of the students of JIT in organizing various aspects of the conference, such as volunteering, assisting with logistics and supporting the smooth flow of sessions, has been invaluable and highly appreciated.

I hope that the hard work in conducting the conference has led to successful results and wish everyone involved all the very best for the future endeavours.

DR. SWADESH SINGH
SOUS-SHERPA

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swadeshs@rmponweb.org

RMP, 136, North Avenue, New Delhi-110001

Date: April 18, 2023

Dear Dr. Jayalekshmi,

I am very pleased to hear from Prof. Vinod Menon, International Coordinator of the C20 Working Group on Sustainable and Resilient Communities: Climate, Environment and Net Zero Targets that The National Institute of Technology Karnataka (NITK) at Surathkal is organising an International Conference on Sustainable Infrastructure: Innovations, Opportunities and Challenges 2023 (SIIOC2023). This International Conference is being organised by NITK in collaboration with the Indian Society for Earthquake Technology (ISET) established in 1962 as a premier organisation of earthquake engineers from civil engineering, structural engineering and geo-technical engineering. SIIOC 2023 covers several themes which are of extreme importance for the G20 Member countries and invited guest countries during India's G20 Presidency.

Dr. Maneesh Ramesh and Prof. Vinod Menon of the above C20 Working Group are supporting NITK, Sri Sringeri Sharda Math supported Jyoti Institute of Technology (JIT), Bengaluru, Indian Institute of Science, Bangalore, National Jute Board, Government of India in three events and are also on the Advisory Council for organising these Conferences as they support the C20 Vision of vision of Sustainable and Resilient Communities which we are trying to promote through various events which we are organising to prepare the policy briefs, white papers and working papers for the C20 platform.

1. NITK's SIIOC 2023 on 20th-21st April 2023
2. Sringeri Sharda Math, NITK and JIT's International Conference on Interdisciplinary Approaches in Civil Engineering for Sustainable Development (IACESD2023),7th & 8th July , 2023 and
3. National Jute Board, Ministry of Textiles, Government of India, NITK Surathkal, and JIT's Conference on Jute Based Geo-Textiles for Sustainable Development. (Date to be decided).

I am pleased to inform you that the C20 Secretariat approves and endorses these events as a part of the C20-G20 efforts by C20 Working Group on Sustainable and Resilient Communities: Climate, Environment and Net Zero Targets so that the concerned institutions can use the G20-C20 logos in these banners and other materials as they are all part of the C20 initiatives of various working groups including SDGs.

Assuring you all support for these events,

Best regards and many thanks,

Dr. Swadesh Singh

COMMITTEES

CHAIRMAN

Prof. N Vinod Chandra Menon

International Coordinator, G20 C20 WG on Sustainable & Resilient Communities: Climate, Environment and Net Zero Targets & Founder Member, NDMA, Govt. of India

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Registrar Evaluation, VTU, Belagavi

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National Institute of Technology Karnataka, Surathkal

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Prof.Shuqing Yang, Smart Infrastructure Facility, University of Wollongong, Australia

Dr.Anupama S, National Institute of Technology Karnataka, Surathkal

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Dr.Amarnath Hegde,Indian Institute of Technology, Patna

Dr.Anil Kumar Sharma,National Institute of Technology, Patna

Dr.Arvind Kumar Jha, Indian Institute of Technology, Patna

Prof.Chandan Ghosh, Head, Geohazards, National Institute of Disaster Management, Govt. of India

Dr.Mahadeb Datta, Dy. Director, National Jute Board, Ministry of Textiles, Govt of India

Dr. Renjitha Mary Varghese,National Institute of Technology, Calicut

Dr. LAM Thanh-Quang-khai, Mien Tay Construction University, Vietnam

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Dr.K Gopalakrishna, Professor & Principal, Jyothy Institute of Technology, Bengaluru

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Dr.B.K Raghu Prasad, Professor(Retd.), Indian Institute of Science, Bengaluru

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Dr.Subhash C Yaragal, Professor, Dept. of Civil Engineering, NITK Surathkal

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Dr.Narendra Reddy, Professor & DBT Ramalingaswami Fellow, CIIRC-Bengaluru

Dr.Prachand Man Pradhan, Professor, Kathmandu University and Dean of Engineering, School of Engineering in Manmohan Technical University,Morang, Nepal

Dr.Anil Joseph, President, Indian Geotechnical Society

Dr.B K. Maheshwari, President, Indian Society of Earthquake Technology

Dr.Sampath G Deshmukh, Dean, SKN Singhad College of Engineering, Pandharpur,Maharashtra

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Mr.R Sundaram, Chairman & Managing Director, Sundaram Architects Pvt Ltd, Bengaluru

Dr.S Kumar, NDT division head, Bureau Veritas, Bengaluru

Er.K N Keshava Prasad, Director, Shilpa Shrungar, Bengaluru

Er.Kishore Hoysal, Zonal Manager-South-Projects, Saint-Gobain India Pvt Ltd, Bengaluru

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Dr. Sreekeshava K.S

Head, Department of Civil Engineering, JIT

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Dr. Chandre Gowda C, Associate Prof., Department of CE, CIIRC

Dr. B N Skanda Kumar, Assistant Prof., Department of CE, CIIRC

Dr. Poonam Shekhawat, Assistant Prof., Department of CE, JIT

Dr. M. T Reddy, Assistant Prof., Department of CE, JIT

Mr. Suresh Y R, Assistant Prof., Department of CE, JIT

Mr. Ganesh C.R, Assistant Prof., Department of CE, JIT

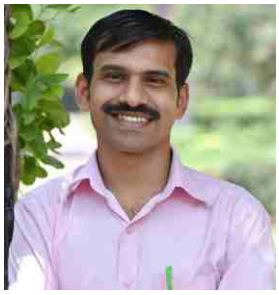
Ms. Bhargavi C, Assistant Prof., Department of CE, JIT

Mr. Nithish S Ambale, Assistant Prof., Department of CE, JIT

Mr. Pavan Kumar V, Assistant Prof., Department of CE, JIT

PROGRAM CHAIR

Prof. N. Vinod Chandra Menon
Honourable Chairman
IACESD-2023



Dr. Sreevalsa Kolathayar
Technical Chair
IACESD-2023

Dr. Sreekeshava K S
Organising Chair
IACESD-2023

KEYNOTE SPEAKERS

Ms. P. Bineesha
Executive Director, International Institute of Waste Management (IIWM)

Prof. Rajib Maity
Professor, Department of Civil Engineering & AK Singh Chair Faculty, IIT Kharagpur

Dr. Manoj P Samuel
Executive Director, Center for Water Resource Development and Management, Kozhikode

Prof. TV Ramachandra
Scientific Officer, Centre for Ecological Sciences, IISc

Dr. Subha Vishnudas
Professor in Civil Engineering, School of Engineering, Cochin University of Science and Technology Cochin -22

Prof. Subimal Ghosh
Professor, Indian Institute of Technology Bombay, Mumbai.

Dr. Neelima Satyam
Professor, Department of Civil Engineering, IIT Indore, Madhya Pradesh

Dr. Narendra Reddy
Professor & DBT Rmalingaswamy Fellow, CIIRC, Bengaluru

Dr. Pijush Samui

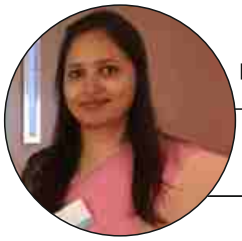
Professor, National Institute of Technology, Patna

Ms. Minimol Korulla

VP & Head - Strategic Projects & Initiatives
Maccaferri ISEAP

Prof Chithirai Pon Selvan

Director, Research & Head of School Science and Engineering Curtin University Dubai, UAE



Dr. M. Geetha Priya

Professor, Centre for Incubation, Innovation, Research and Consultancy (CIIRC), Bengaluru

Dr. Bibhuti Bhushan Das

Associate Professor, National Institute of Technology Karnataka-Surathkal

Dr. Arvind Kumar Jha

Assistant Professor, Indian Institute of Technology Patna

Dr. Anupama S

National Institute of Technology Karnataka-Surathkal, Mangalore, Karnataka-575025

Dr. Mithun Mohan

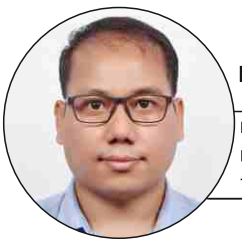
National Institute of Technology Karnataka-Surathkal, Mangalore, Karnataka-575025

Dr. Ramkrishnan R

Scientist C, Central Academy for State Forest Service, Ministry of Environment Forest and Climate Change

Dr. Keertana K

Assistant Professor, Dept of Civil Engg., Indian Institute of Technology Madras (IIT-M)



Dr. Kunjari Mog

Post-Doctoral Fellow, Dept. of Civil Engineering, Indian Institute of Technology Bombay

Jyothy Charitable Trust ®

JYOTHY INSTITUTE OF TECHNOLOGY

(Approved by AICTE, Affiliated to VTU)

Cordially Invites you to the Inaugural Session of

INTERNATIONAL CONFERENCE

ON

INTERDISCIPLINARY APPROACHES IN CIVIL ENGINEERING FOR SUSTAINABLE DEVELOPMENT (IACESD-2023)

on

07th July 2023, 09.30 AM onwards

Venue: Main Auditorium, Swami Vivekananda Block

Organized by:

DEPARTMENT OF CIVIL ENGINEERING

Accredited by National Board of Accreditation (NBA)

Springer

SPRINGER NATURE

Chief Guest

Prof. N. Vinod Chandra Menon

International Coordinator, G20 C20 WG on Sustainable &
Resilient Communities: Climate, Environment & Net Zero Targets
Founder Member, NDMA, GoI
Honourable Chairman, IACESD-2023

Guest of Honour

Dr. Jija Madhavan Harisingh, IPS(Retd.)

Former DGP Civil Defence,
Fire & Emergency Services,
GoK, Bengaluru

Presided By

Smt. B V Seetha
Chair Person
Jyothy Charitable Trust

Sri. M Narasimhan
Vice Chairman
Jyothy Charitable Trust

Mr. B. K. Ramesh
Member
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Dr. Krishna Venkatesh
Director, CIIRC
Jyothy Institute of Technology

Dr. K Gopalakrishna
Principal
Jyothy Institute of Technology

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Dr. Sreevalsa Kolathayar
National Institute of Technology,
Suratkal, Mangalore, Karnataka
Technical Chair, IACESD-2023

Dr. Sreekeshava K S
Jyothy Institute of Technology,
Bengaluru, Karnataka
Organising Chair, IACESD-2023

Schedule of Inaugural Session

09:30 AM	Invocation
09:35 AM	Lighting the Lamp
09:40 AM	Welcome Address by Dr. K Gopalakrishna,Principal, JIT
09:45 AM	About IACESD-2023 by Dr. Sreevalsa Kolathayar, Technical Chair, IACESD-2023
09:50 AM	Release of Souvenir (Abstract Book)
09:55 AM	Felicitation Program
10:10 AM	Address by the Chief Guest & Hon'ble Chairman Prof. N Vinod Chandra Menon
10:20 AM	Keynote Address by Guest of Honour, Dr. Jija Madhavan Harisingh
10:30 AM	Presidential Address
10:35 AM	Vote of Thanks by Dr. Sreekeshava K S, Organising Chair, IACESD -2023
10:40 AM	National Anthem

INTERNATIONAL CONFERNCE ON INTERDISCIPLINARY APPROACHES IN CIVIL ENGINEERING FOR SUSTAINABLE DEVELOPMENT(IACESD-2023)

TECHNICAL SESSIONS(OFFLINE)

DAY 1 - 07/07/2023

GLASSDOOR	09:00-09:30	REGISTRATION
MAIN AUDITORIUM	09:30-10:30	INAUGURATION CEREMONY
	10:30-11:00	HIGH TEA
VENUE	TIME	KEYNOTE SCHEDULE
MAIN AUDITORIUM	11:00-11:40	Dr. Manoj P Samuel,Executive Director, Center for Water Resource Development and Management, Kozhikode
AIC SEMINAR HALL	11:00-11:40	Prof Chithirai Pon Selvan, Director, Research & Head of School Science and Engineering Curtin University Dubai, UAE
ACS SEMINAR HALL	11:00-11:40	Dr. M. Geetha Priya, Professor, Centre for Incubation, Innovation, Research and Consultancy (CIIRC), Bengaluru
MAIN AUDITORIUM	11:40-12:20	Dr. Arvind Kumar Jha, Assistant Professor, Assistant Professor, Indian Institute of Technology Patna
AIC SEMINAR HALL	11:40-12:20	Dr. Keertana K, Assistant Professor, Dept of Civil Engg., Indian Institute of Technology Madras (IIT-M)
ACS SEMINAR HALL	11:40-12:20	Dr. Kunjari Mog, Post-Doctoral Fellow, Dept. of Civil Engineering, Indian Institute of Technology Bombay
MAIN AUDITORIUM	12:20-1:00	Prof. Rajib Maity, Professor, Department of Civil Engineering & AK Singh Chair Faculty, IIT Kharagpur
ACS SEMINAR HALL	12:20-1:00	Dr. Subha V, Professor in Civil Engineering, School of Engineering, Cochin University of Science and Technology

02:00-03:30

SESSION	CATEGORY	VENUE	TIME	TITLE	CORRESPONDING AUTHOR	EQUINOCS PAPER ID
1.1	STRUCTURAL ENGINEERING	AEC	02:00-02:10	A Study on Repair Effectiveness of Damaged RC Beams with Circular Openings Using CFRP Sheet	SRIHARI NIKHIL J	164
			02:10-02:20	A Review on Current Materials, Their Failures & Advancements in Railway Sleepers	P GIRISH	177
			02:20-02:30	Combined Metakaolin and Ground Granulated Blast-furnace Slag induced Concrete for Marine Environment	THOMAS NYNWEPH GMAWLUE JR	197
			02:30-02:40	Optimization Studies on Bracing Systems and its Effective Placement to Counteract Earthquakes in Very High Damage Risk Zone	Usha S	447
			02:40-02:50	Study on compression strength of masonry prism using cementitious grouting material as mortar	KAVYASHREE K	497
			02:50-03:00	Studies on Flexural and Shear bond strength of masonry using cementitious grouting materials as mortar	MANIRANGANATH H G	505
			03:00-03:10	Assessment of Periphery Free-Standing Masonry Wall For Structural Safety And Integrity	Arun Kumar N	516
			03:10-03:20	Analysis and Design of Steel Skywalk Bridge	GAGANA P.	520
			03:20-03:30	Structural Health Monitoring of Bridges using IoT	ADITYA S	672
1.2	GEOTECHNICAL ENGINEERING & PAVEMENT	AIC	02:00-02:10	FORSTERITE TREATED SILT AS A LINER MATERIAL	DEEPA K A	170
			02:10-02:20	LABORATORY INVESTIGATION OF SOIL STABILIZATION USING TERRAZYME AND CEMENT	K SNEHA SAGARI	117
			02:20-02:30	A study on flexural fatigue performance of cement treated base in flexible pavements due to repetitive loading	SHIVA PRASAD N	494
	ENV.ENGG		02:30-02:40	Assessment of the carbon footprint of green concrete liners in landfill construction critical review	G V RATHNAMALA	87
			02:40-02:50	Novel Carbonaceous Cubic Spinel Ferrite for Removal of Cd(II) ion from Industrial Effluent	Nisha R	591
	TRAFFIC & URBAN PLANNI		02:50-03:00	IMPACT ANALYSIS OF MODAL SHIFT ON TRANSPORT ECOLOGICAL FOOTPRINT IN BENGALURU	Ann Das	107
	NATURAL HAZARDS		03:00-03:10	Comparative Analysis of Machine Learning Models for Earthquake Prediction using Large Textual Datasets	NITEESH K R	451
			03:10-03:20	Enhancing Flood Forecasting Accuracy through Machine Learning Approaches	HALAPPANAVAR RUTA SHIVARUDRAPPA	342
1.3	BUILDING MATERIALS & TECHNOLOGIES	ACS	02:00-02:10	Inclusion of different plastic wastes as Construction Material in concrete	DIVYA NAIR	265
			02:10-02:20	Development of Thin Joint Masonry using Recycled Mortar for Sustainability	MOHD IMRAN AHMED	282
			02:20-02:30	Application of Dry Grinding as an Optimisation Tool for the Surface Area development in Geopolymer Cement Manufacture.	ZVIKOMBORERO LAZARUS DURI	305
			02:30-02:40	BIM-BASED INTEGRATED APPROACH FOR DESIGN AND CONSTRUCTION PLANNING OF BUILDING PROJECTS	HEMANTH KUMAR N	427
			02:40-02:50	Use of Reclaimed foundry sand (RFS) as fine aggregate in Mortars and Concrete	VENUGOPAL G	504
			02:50-03:00	ENHANCING THE DURABILITY OF CONCRETE WITH AGRICULTURAL BAGASSE ASH	G D KUMARA	547
			03:00-03:10	Mechanical Behaviour of Geo-Polymer Concrete	KARTHIK M H	272
			03:10-03:20	Group Indexing of Fly Ashes using Unsupervised Learning and Fuzzy Clustering Techniques	Chandana Priya K C	583
			03:20-03:30	A Review on Different Processing Methods to Improve Pozzolanic Properties of Agricultural Waste Ashes	ABHISHEK R	472
			03:20-03:30	Structural Health Monitoring by simultaneous measurement of Strain and Temperature using different materials	SOMESH NANDI	557

03:40-05:00

2.1	STRUCTURAL ENGINEERING	AEC	03:40-03:50	Experimental Investigation on the Strength of Stabilized Geopolymer Mud Blocks with various types of Mortar	RAMYA M S	560
			03:50-04:00	Performance Evaluation of Fire Exposed RC Structure using Pushover Analysis	K MAHAMMAD JAFAR	522
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AIC SEMINAR HALL	10:10-11:00	Dr. Ramkrishnan R,Scientist C, Central Academy for State Forest Service, Ministry of Environment Forest and Climate Change
ACS SEMINAR HALL	10:10-11:00	Dr. Anupama S, National Institute of Technology Karnataka-Surathkal, Mangalore, Karnataka
MAIN AUDITORIUM	11:00-11:40	Prof. TV Ramachandra,Officer, Centre for Ecological Sciences, IISc
AIC SEMINAR HALL	11:00-11:40	Dr. Neelima Satyam,Professor, Department of Civil Engineering, IIT Indore, Madhya Pradesh (VIRTUAL)
ACS SEMINAR HALL	11:00-11:40	Dr. Mithun Mohan, National Institute of Technology Karnataka-Surathkal, Mangalore
MAIN AUDITORIUM	11:40-12:20	Dr. Pijush Samui,Professor, National Institute of Technology Patna
ACS SEMINAR HALL	11:40-12:20	Dr. Bibhuti Bhushan Das, Associate Professor, National Institute of Technology Karnataka(VIRTUAL)
AIC SEMINAR HALL	11:40-12:20	Ms. Minimol Korulla, VP & Head - Strategic Initiatives & Projects - ISEAP at Maccaferri ISEAP(VIRTUAL)
MAIN AUDITORIUM	12:20-01:00	Prof. Subimal Ghosh,Professor, Indian Institute of Technology Bombay, Mumbai (VIRTUAL)

02:00-03:15

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	IRRIGATION & WATER RESOURCES		02:30-02:40	Towards Selection and Improving the Performance of the SWAT hydrological model: A Review	YASHAS KUMAR H K	188
			02:40-02:50	Development of low cost fiber reinforced concrete sluice gate to mitigate floods in small dams	DEEPTHI B.R	576
			02:50-03:00	Groundwater potential zones of kunigal taluk using remote sensing ang GIS	RAVINDRANATH C	605
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	STRUCTURAL ENGINEER		03:10-03:20	Effect of Localised Damages on the Buckling Behaviour of Slender RC Columns	DR.RAJANNA T	657
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KEYNOTE ABSTRACTS

Hydrological Alterations Under Climate Change: Global-Scale Challenges and Opportunities for Adaptation and Sustainable Development.

Prof. Rajib Maity, Professor
Indian Institute of Technology Kharagpur.

Caused by the climate change, the anticipated alterations in the hydrological cycle are expected to have significant effects and potential hazards on social and ecological systems. It is realized that the catastrophic weather events like droughts and floods are becoming increasingly frequent. Between 1970 and 2019, 31% of all economic losses were caused by floods, while 7% of all catastrophe occurrences globally were connected to drought. Thus, the anticipated alteration may impact the physical dimensions of water security due to the climate change, exacerbating ongoing vulnerabilities associated with water management in the socio-economic context. In this context, this talk will highlight some of the recent findings in hydrological analysis – both across the globe and India. Some of the recent findings on the change in the extreme precipitation characteristics and changing pattern of Intensity-Duration-Frequency (IDF) relationship due to Climate Change will also be discussed.

Conservation of Wetlands: Ecosystem-Based Adaptation of Climate change

Dr. T.V. Ramachandra
Co-ordinator, Energy & Wetlands Research Group, Centre for Ecological Sciences [CES] & Convenor, Environmental Information System [ENVIS], CES TE 15, Indian Institute of Science, Bengaluru, Karnataka, 560 012, India.

Wetlands are productive ecosystems providing an array of services that sustain the well-being of dependent biota. Post industrialization and globalization era witnessed a spurt in the anthropogenic activities leading to the degradation and decline of fragile ecosystems. This necessitates the conservation of vital ecosystems through sustainable management tenets, which requires an understanding of the livelihood support of ecosystems. The provisional services through accounting of tangible benefits (fish, fodder, water, etc.) considering residual values indicate an annual revenue of 49.70 billion rupees. Similarly, accounting of non-use values of ecosystems through the benefit transfer method indicates regulating and cultural services support of 196.89; and 37.93 billion rupees/year, respectively. The annual flow of total ecosystem supply value accounts for 284.52 billion rupees/year and the net present value amounts to 7320.6 billion rupees, which signifies the ecological, social-cultural, and environmental support wetland provides ecosystems in Karnataka. Appraisal of ecosystem services (ES) allows for adjusted national accounts which reflect the output of ecosystem services as well as the depletion of natural resources and the degradation costs (externalized costs of the loss of ecosystem services) of ecosystems in economic terms, which will help raise awareness and provide a quantitative tool to evaluate the sustainability of policies toward prudent management and conservation of fragile livelihood supporting ecosystems. The monetary valuation of ecosystem services can help in building a better understanding of their influence on well-being and can further facilitate information-driven decisions and policy reforms that align with the Sustainable Development Goals (SDGs) through the wise use of natural resources.

Sustainable Water Management and Climate Smart Agriculture for Livelihood and Food Security

Dr Manoj P. Samuel
Executive Director,
Centre for Water Resources Development and Management, Kozhikode.

Land and water are among the most important of all natural resources, hence maintaining these resources are essential for sustainable development specially to sustain the agricultural productivity. Land and water are vital resources in urban, agricultural, and natural ecosystems. The availability of water has become unpredictable with the disruption in weather pattern due to climate change. Proper understanding and modelling of climate variability are essential for efficient and sustainable utilization of water resources. Under rapidly changing environment, sustainable water management through targeted research on each sphere of soil: plant: water continuum is essential and to increase food production through enhancing water productivity, identifying adaptation needs and addressing the challenges and research directions in water management in humid tropics are of great importance. The productivity of most of the crops is low in many parts of the country, when compared to the global average productivity. Lack of irrigation and low fertile lateritic soils are some of the important factors contributing to this low productivity. These are coupled with the serious unresolved problems such as high labour charges and high cost of cultivation and due to this, the farming community is in a deplorable plight. The country faces the challenges of both increasing farm productivity and increasing sustainability and resilience to climate change. Effective government intervention based on modern tools and technologies, with people's participation is the need of the hour to save the grave crisis faced by farmers. One of the major factors which affect the production and productivity of agricultural crops is crop water management. In view of increasing water demand and shrinking supply, the only way to ensure sustainable agricultural production is to enhance the water use efficiency. The efficiency of conventional irrigation systems is less and hence there is a need for greater awareness among the farming community to adopt new practices including micro-irrigation systems. Institutional innovations coupled with novel practices and technologies in irrigation sector is the need of the hour. The water conveyance, distribution and application efficiencies in traditional systems of irrigation are also to be improved. Community management of water resources, participatory irrigation systems, recycling of grey water for irrigation, pollution management of water resources etc. are also vital for productivity enhancement of crops. New approaches and technologies like water budgeting of major crops in various agro-climatic-ecological zones, AI/ML/Sensor based irrigation scheduling, automated irrigation, conjunctive use of surface and groundwater, climate smart irrigation, and drought proofing models are to be linked to the irrigation planning and operations. Community-based micro-irrigation systems can be introduced to agricultural areas that were earlier under rainfed agriculture and faced crop failures due to scanty rainfall. The introduction of micro-irrigation systems would help to bring down pressure on groundwater resources, enhance the yield and quality of the produce and reduce the farm energy and fuel consumption, leading to considerable reduction in Green House Gas emissions.

Civil Engineering Concepts in Sustainable Development – Key to attain SDGs

Dr. Subha Vishnudas
Professor Cochin university of science and technology, Kochi, Kerala.

Global development trends today are unsustainable. The biggest reason for this lies with our society's consumption and production patterns. It has been widely recognized since 1992 at the Rio Earth Summit -that we need to change the way we produce and consume. The United Nations' 2030 Agenda for Sustainable Development readdressed this issue and included as the 12th Sustainable Development Goal - Responsible Consumption and Production. Every human being living in this planet is committed in radically altering the society's practices of producing and consuming goods and services. Unsustainable patterns of consumption and production are the root cause of the planetary crises: climate change, depletion of natural resources, biodiversity loss, pollution and are still persisting. These crises, and related environmental degradation, threaten human well-being and achievement of the Sustainable Development Goals. We the human are responsible for this and hence each individual should work together to improve resource efficiency, reduce waste and pollution, and shape a new circular economy.

Construction industry is facing a number of challenges related to depletion of resources, accessibility to affordable materials, disposal of waste materials and generation of greenhouse gases. Natural resources such as clay, lime stone, laterite and granite are depleting due to the excessive consumption during infrastructural development activities. The construction activities generate enormous amount of waste which is usually disposed of by land filling. It causes environmental pollution and reduction in usable land. These activities cause emission of large volume of greenhouse gases which in turn leads to global warming and associated problems. In this context, environment friendly approach on construction becomes very significant and essential.

Due to urbanization, rapid population growth, changing life styles, food habits, living standards and many other administrative and technical problems, growth of cities are with typical problems of unplanned urban development especially in the case of waste management. For a successful and sustainable water management, watershed should be used sustainably. For this, four main elements need to be considered: natural resources, technology, institutions and economics. A suitable metaphor for these four elements is a chain of shackles, the chain being as strong as the weakest shackle.

These three main issues of civil engineering in the context of sustainable development emphasizing 12th SDG - sustainable water &waste management and building materials with research findings is being addressed in this presentation.

Real Time landslide monitoring and Development of early warning in Himalayan Region

Dr. Neelima Satyam, Professor
Indian Institute of Technology, Indore

Landslides are geomorphological processes those turn into disaster when interact with human environment. When rainfall is the primary triggering factor of landslides, the occurrence of landslides can be forecasted using a critical rainfall condition, known as the rainfall threshold. The choice of rainfall parameters depends primarily on the typology of landslides. An approach, combining the effect of both long-term and short-term rainfall is more suitable, when a region is affected by both deep-seated and shallow landslides. Kalimpong in Darjeeling Himalayas is one such mountainous town, where multiple landslide types are observed. The town is in the West Bengal state and is frequently affected by landslides. Rainfall thresholds using several approaches (Satyam and Abraham, 2021). From these studies, it was found that the method studying both long-term and short-term rainfall is performing much better than the conventional approaches (Abraham et al., 2020). This has been done using SIGMA (Sistema Integrato Gestione Monitoraggion Allerta) model, which is an operational LEWS, originally developed for Italy. The model has over 20 years of operational experience, and is being updated and fine-tuned regularly for better performance. Apart from Italy, the model has been tested for Kalimpong in the Darjeeling Himalayas and Idukki in the Western Ghats. The critically unstable slopes in Kalimpong town are monitored using MicroElectroMechanical Systems (MEMS) tilt meters and volumetric moisture content meters and the recent studies on updating rainfall threshold models have proved that the use of field-based data can improve the performance of conventional thresholds significantly. Hence this study is an attempt to update the SIGMA model for Kalimpong using latest rainfall and landslide data and explore the use of field-based monitoring data for improving the performance of SIGMA Model.

Potential of Agricultural Residues as Sustainable Resources for Civil Engineering

Dr. Narendra Reddy
Professor, CIIRC, Jyothy Institute of Technology

Applications Agricultural residues are inevitably generated and account for 1 to 5 times the amount of the produce. Despite having cellulose, hemicellulose and lignin which are valuable polymers as the major constituents, most of the residues are either burnt or buried without any major application. Such disposal of the residues is not only a economical loss but also causes considerable environmental and health pollution. It has been estimated that more than 300 million tons of agricultural residues are generated in India every year. Many agricultural residues have unique properties such as inherent antimicrobial resistance, flame retardancy and thermal insulation properties. Hence, utilizing agricultural residues for civil engineering applications will provide a sustainable, economical and abundant local resource. In this paper, we present the potential of using agricultural residues for ceiling tiles, reinforcement for concrete and other civil engineering applications.

Hybrid Artificial Intelligence in Civil Infrastructure

Dr Pijush Samui
Professor, National Institute of Technology, Patna.

Hybrid Artificial Intelligence (AI) is used to solve various problems in infrastructure engineering. In Hybrid AI, metaheuristic optimization algorithm is used to minimize the error. Hybrid AI learns the input output relationship from the data itself. The quantity and quality of the data govern the performance of Hybrid AI. In this keynote, it is planned to discuss several Hybrid AI tools [Least Square Support Vector Machine (LSSVM); Artificial Neural Network (ANN); Adaptive Neuro Fuzzy Inference System (ANFIS)] applicable to the various problems of infrastructure engineering. Various examples will be given to show the working procedures of hybrid AI models in different fields of infrastructure engineering such as concrete; liquefaction, retaining wall, etc. Participants will know the use of MATLAB for development of different Hybrid AI techniques. The practical application of various AI will be discussed in the field of infrastructure engineering. The advantages of different Hybrid AI techniques will be also described.

The Role of Engineering Education for Sustainable Development

Prof Chithirai Pon Selvan
Director – Research and Head of School – Science and Engineering
Curtin University Dubai

Since most natural resources are on the verge of being depleted, the world is concentrating on environmentally friendly technology. Sustainable development is about forms of progress that combine economic development, social advancement, and environmental protection and is widely recognized by the public, private, and civic sectors as one of the key challenges for the 21st century. The current engineering education focused solely on developing technologies to meet the demands of large consumer markets. On the other hand, there is a lack of emphasis placed on material sustainability, concern for the environment, greenhouse gases, and other forms of livelihood. Considering recent revelations about the state of the world's ecosystems, technological experts have begun advocating for policies that will protect the planet. Redesigning materials and products for circular use would boost innovation across different sectors of the economy. Learners in higher education are significant future stakeholders. Their enthusiasm as aspiring engineers, scientists, leaders, and decision-makers will make a difference. Positive change begins with awareness. Awareness empowers people to act. This presentation will raise awareness by providing a more comprehensive understanding of sustainable development. The global perspectives on climate change and the status of some of the important resources are also discussed.

Sustainable Slope Stability Solutions Using Flexible Technologies

Ms Minimol Korulla
VP & Head - Strategic Projects & Initiatives – ISEAP
Maccaferri, ISEAP

Sustainability is the need of the hour especially for Hilly Terrains of India. Our vast country is having severe slope instability problems especially in Himalayan and Konkan states. If we adopt conventional rigid structures, they may deteriorate or crack within a certain period of time. Hence the industry is at present looking for more flexible, ecofriendly and free draining solutions like Reinforced soil systems, Drapery solutions and Rock fall barriers. Few of such solutions are already covered in National standards like Hill Road Manual. However, it is important to create more awareness and skill development among technical community for the popularization of such ecofriendly technologies. The flexibility of such technology will prevent the system to undergo any sudden collapse or failure and they can take dynamic forces to a great extent.

Monitoring of Melt Ponds and Supra- Glacial Lakes Over Nivlisen Ice Shelf, East Antarctica Using Space-Borne Multispectral Data

Dr Geetha Priya M
Professor, CIIRC
Jyothy Institute of Technology.

An ice shelf is a large and thick expanse of floating ice that remains attached to the coastline or the edge of a landmass. These ice shelves are predominantly created by the continuous build-up and outward movement of glaciers that originate from the landmass and extend into protected water bodies. The ice gradually stretches and expands over time, forming a steady and robust foundation. The objective of this research is to observe and track the formation and changes of melt ponds and supraglacial lake on the surface of the ice shelf region. This is accomplished by analysing the depth of these ponds through the use of multispectral data obtained from Lansat-8 & Landsat-9 satellites during the Austral summer of 2021-2022 & 2022-2023. By monitoring and quantifying the melt pond depths, the study aims to provide a comprehensive understanding of the melting patterns and trends of the ice shelf region. The present study was carried out over the Nivlisen ice shelf in central Droning Maud land (cDML), East Antarctica. To assess the evolution of the melt ponds and supraglacial lake during the aforementioned period, the depth and volume of the ponds were estimated utilizing a Melt Pond Depth Model (MPD) by examining the spectral properties of the reflected radiation. The results of the study state that the maximum depth of the melt ponds was seen to be increased by 2 times and the volume of the meltwater was also increased by 8 times in comparison from February 2022 to February 2023. The model-based results have been validated by ground truth data collected during the Austral summer of 2022-2023 over a melt pond in cDML. This increase in depth and volume could have significant implications for the stability of the ice shelf in the region. Exposure to prolonged and pronounced surface melting conditions fosters the formation of melt ponds and supraglacial lake which will accelerate the ice flow and cause de-stability in ice shelves.

Influence of Phase Change Materials on Thermal Properties of Nano Silica Admixed Cementitious Mortar

Dr. Bibhuti Bhusan Das
Associate Professor,
National Institute of Technology Karnataka, Surathkal

The present study demonstrates the influence of integrating phase change materials (PCMs) on thermal properties of nanosilica admixed cementitious mortar. First, the optimized dosage of nanosilica in correspondence to compressive strength was determined. Subsequently, the desired proportion of PCMs was identified pertaining to a designated compressive strength. Thermal properties were determined by means of differential scanning calorimetry (DSC). Incorporation of nanosilica into the cementitious mortar was found to have a positive influence on early strength development and durability, however, there was found to be an increase in chemical shrinkage as compared to the control mixture. PCMs integrated cementitious mortar improved the thermal efficiency as well as reduced the chemical shrinkage, but adversely affected the mechanical, hydration, and durability properties. With respect to development of compressive strength of the cementitious mortar, it is found that n-octadecane PCMs performed better amidst other PCMs, such as paraffin and sodium carbonate hydrates. Further, studies were carried out on cementitious mortar having both nanosilica (optimized proportion) and PCMs (the best performing). From the results, it is found that cementitious mortar comprising of both nanosilica and PCMs have compensated the drawbacks of one another. Blended mortar (having both nanosilica and PCMs) showed superior strength gain at early age, better durability resistance, low chemical shrinkage, and superior thermal performance.

Mechanical Behaviour of Lime Treated Soil Subjected to Varying Metal Sulphates Contamination

Dr. Arvind Kumar Jha
Assistant Professor,
Indian Institute of Technology, Patna.

Potential of lime treatment subjected to various physicochemical conditions is still mattered of concerns. Further, distress of lime treated soil subjected to gypsum has caused due to complex ionic reactions and thereby formation of highly expansive ettringite/thaumasite. However, acid mine drainages or acid sulphate soils contain various sulphides and other heavy metals such as CaSO4, Na2SO4, MgSO4 and K2SO4 which eventually lead to contaminate the soils. Treatment of such sulphates contaminated soil by using calcium-based stabilizer (lime) induces more complexity in ionic reactions depending upon types of metal sulphates or cations and thereby resulting change in mechanical behaviour. Hence, present study has aimed to elucidate the effect of varying metal sulphates contamination on mechanical behaviour of lime treated expansive soil. Further, longevity potential of lime treated soil subjected to metal sulphates is also explored and explained in detail.

Identifying The Factors Affecting Users' Safety at Bus Stops: A Step Towards Improving Bus Ridership

Dr. Mithun Mohan
Assistant Professor
National Institute of Technology Karnataka, Surathkal

Traffic on the Indian road is increasing tremendously; due to this, the existing infrastructure facilities are being choked to cater to the current demand. Widening existing roads is an option. However, this will ultimately add more vehicles onto the road, and the issue continues. The only viable option in such a case is to shift the road users towards mass transit facilities. The bus is one example of such facilities, often dropping users close to their destination. However, it is vital to understand the factors that attract people towards them to increase the ridership of the public transportation system. This study tries to understand the factors that influence the safety of passengers waiting at bus stops. Improving the existing facilities in light of these identified factors would enable the planners to adopt cost-effective strategies for attracting more users towards transit facilities.

Linear Joint Time Frequency Analysis Based Simulation of Earthquake Motions for North and Central Himalayas

Dr. Ramkrishnan R
Scientist C Ministry of Environment, Forest and Climate Change

Traditional methods like Fourier analyses and Fourier transforms that use the time or frequency domain alone are unreliable for analyzing seismic motions due to their inability to scrutinize individual and temporal frequency contents. This calls for analyzing the motions in joint time-frequency domains to acquire the ideal frequency and temporal features. Recent developments in seismic studies have brought forth the constructive application of Joint Time-Frequency Analysis (JTFA) techniques in analyzing and synthesizing earthquake motions. The present study deals with a novel JTFA-based synthesis of earthquake motions for the Himalayas, one of the most active seismic areas in the world with a limited seismogram network. In the current study, Wavelet Transform (WT) is adopted due to its better resolution and less spectral leakage when compared to other TFA techniques. Ground motion data for the region is collected from PESMOS, IIT Roorkee (pesmos.com/). Earthquake motions were synthesized for a magnitude and distance range of 4 to 6 and 0 to 280 km, respectively, using actual recorded data. Response spectra were developed for a random and synthetic time-history in all magnitude and distance ranges. Further, the spectral contents of synthetic and actual time-histories were compared using spectrograms and Fourier Transforms to assess and supplement the results. Synthetic generic accelerograms for these magnitude and distance ranges were developed based on the actual recorded data using a hybrid Wavelet Synchro-Squeezing Technique (WSST), which was found to be a good match with the true signal pattern in terms of frequency content and response spectra.

Sustainable Construction Technologies – A Way Forward

Dr. Keerthana Kirupakaran
Assistant Professor
Indian Institute of Technology Madras

Concrete is grey, both literally and metaphorically. However, there is a constant effort by the scientific community towards making it green through several innovative construction technologies and materials. It is well known that about 10% percent of total CO2 emissions can be traced back to cement production. However, not much attention is paid to embodied CO2 emissions arising from production, transportation, construction, and demolition. Additionally, operational CO2 emissions arising due to operation of a building which includes electricity source, ventilation, air conditioning, lift and automatic door etc. are often not accounted for. To truly understand the sustainability potential of emerging technologies is it important to assess the energy consumed over entire life from cradle to grave. This paper/talk will give an overview on the past and ongoing efforts of the scientific community towards durable and sustainable construction technologies. This overview will span supplementary cementitious materials, utilization of construction and demolition waste in the new construction, innovative technologies such as 3D printing, textile and fibre reinforced concrete which enable lean construction, role of AI, robotics and automation in the construction industries and the significance of standards and policies to enable the implementation of these new technologies. The paper/talk will conclude with the emphasis on the systems thinking approach as a way forward to attain sustainability in the construction industry.

Low-Cost and Sustainable Foldscope-Based Method for Particle Shape Characterization of Geomaterials and its Effect on Dynamic Shear Modulus

Dr. Kunjari Mog
Institute Post-Doctoral Fellow
Dept. of Civil Engineering, Indian Institute of Technology Bombay

The paper will focus on the use of a Foldscope-based approach for measuring the morphology of soil particles in geotechnical engineering laboratories. The proposed method is a convenient and novel approach for particle measurement, which is less time-consuming and economically viable. The results obtained from the Foldscope-based method have been compared with those obtained from the Scanning Electronic Microscope (SEM), and the comparison reveals that the results are very similar. This similarity confirms that the Foldscope can be used as a scientific tool for imaging and quantifying the particle shape of geomaterials. The proposed method is sustainable and reduces the need for expensive equipment. The talk will also present the results of the torsional resonant column tests on the test materials characterized using the Foldscope-based method, which will help in understanding the particle shape effect on the dynamic shear modulus of granular soil. Overall, the proposed Foldscope-based approach offers a promising and sustainable alternative for particle measurement in geotechnical engineering laboratories.

Contents

Building Materials & Technologies

Paper ID 002

Effect of Rheological Properties of the Composite on Stress-Strain Behaviour of Moulded Structure

Andrii Kondratiev[1], Oleksii Vambol[2], Maryna Shevtsova[2], and Tetyana Nabokina[2]
[1] O.M. Beketov National University of Urban Economy in Kharkiv, Marshal Bazhanov St., Kharkiv 61002, Ukraine
[2] National Aerospace University "Kharkiv Aviation Institute", Chkalova St., Kharkiv 61070, Ukraine

Civil engineering is an integral part of the effective use of polymeric composite materials. A promising direction is to use composites for the strengthening of reinforced concrete structure. Solidity of these products, their structure and accuracy of making the repair are largely associated with the manifestation of residual technological stresses, which occur during moulding. The paper deals with the study of stress-strain behavior of the moulded composite structure in the process of its cooling. It is shown that both physico-mechanical characteristics of materials and rheonomic properties of the moulded product should be taken into account when the cooling stage is designed. Analytical dependences of the effect of rheonomic properties on the stress-strain behavior of the moulded composite package at the cooling stage have been obtained. These dependences also allow calculating the process parameters of stepwise cooling stage. It is demonstrated that the phenomena of creep and relaxation in the structure at the cooling stage may lead to increase in the process-induced deformations and reduction of stresses in the moulded product. The method for determination of the moulding process parameters (temperature, time) which provide the regulated stress-strain behavior of the structure has been developed. The results allow improving the accuracy of calculations of process-induced stresses and deformations and providing an additional opportunity to optimize the cooling mode (choosing of temperature holding time) for the reduction of residual stress and deformation level.

Keywords: Energy efficiency; Creep; Relaxation; Cooling; Process parameters

Paper ID 072

Progress of Investment Projects in Civil and Industrial Construction

Cong Bang Truong
Mien Tay Construction University

The plan for the schedule is a structure that may be relied on for some aspects of project planning, scheduling, monitoring, and management. The tasks, work packages, and work elements that make up a schedule are all dependent on one another, and the schedules also indicate when particular individuals need to be ready to complete certain work. In addition to this, it helps to verify that departments and divisions are communicating effectively with one another, which is necessary for determining how long it will take to finish the project. The plan for the timetable specifies key tasks that, if delayed, would cause the duration of the project to increase, as well as free-time activities that may be postponed for a certain amount of time without causing any damage. impact the timeline of the project, or activities with surplus resources may be able to temporarily coordinate the operations of other tasks. In addition to this, it helps identify when work can be begun or when it absolutely needs to be started in order to keep the project on time. The planning and management of the project implementation schedule is not rigorous and scientific, which leads to long-term drag. This is currently the most pressing problem, but there are still a few other pressing difficulties as well. One of the most significant problems is that the benefits of the project implementation schedule are being delayed. A protracted period of implementation produces a pooling of money in investment. The current state of construction project implementation in the Mekong Delta is presented by the author in this article. This paper provides a basis for further studies to be conducted in order to discover answers to the problems that are presented.

Keywords: Schedule, Project, Management, the plan, Investment.

Paper ID 134

Challenges and Opportunities for Sustainable Construction Demolition Waste Management in India: A Review of Policies, Practices and Prospects

Ganesh V. Tapkire[1], Dr. Shashi Ranjan Kumar[2]
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Construction and Demolition waste management in India is a Critical issue due to the massive amount of waste generation and the environmental impact of improper disposal. The study reviews the current state of CWD management in India, including the policies and regulations, the challenges faced and potential solution for sustainable CDW management. The paper proposes the adoption of circular economy principles such as reuse, recycling and redesign of CDW, to reduce the environmental impact and create economic opportunities. Moreover, the study highlights CDW management initiatives in India, such as the use of recycled CDW in road construction, establishment of construction and demolition waste processing facilities and the integration of CDW management. As per the survey the types of waste material having applicable strength and might be used for construction work again most of the researcher suggests the use of recycled material in construction. The paper emphasizes the urgency of addressing the CDW management issue in India and the need for collaboration between the government, the private sector, and the community to achieve sustainable CDW management.

Keywords: Construction and Demolition waste, 3R Reduce, recycle, Redesign Policy.

Paper ID 147

Experimental Investigation on Influence of Natural Fibers on Strength Properties of Concrete

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Considering global warming issues in the environment, there has been a rapid growth in research and innovation in the natural fiber composite area. The natural fiber compo-sites have major advantages over the synthetic based fibers. Beside the low cost and the light weight, bio-based polymer composites (natural fibers) gained more attention due to their renewability and biodegradability. The natural strands, for example, coir, palm, kenaf, jute, sisal, banana, pine, sugarcane and bamboo and so on. The study investigates the various influence of natural fibers (jute and coir) on concrete by varying proportions by weight of cement. The experimental work on concrete were conducted by varying the mix proportions of fibers in concrete by weight of cement. The strength properties of concrete were performed and the results are tabulated. The strength results are compared with the conventional concrete and the results were tabulated. According to the work of researchers, the use of natural fibers as partial replacement in concrete or varying proportions by weight of cement has a distinct advantage over the synthetic fibers. Because of its beneficial effect, the natural fibers especially jute fiber can be used for any structural purpose.

Keywords: Natural fibers, Mechanical properties, compressive strength, split Tensile strength.

Paper ID 152

Prognosis of Concrete Strength: The State of Art in using Different Machine Learning Algorithms

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Advancements in machine learning and their algorithm have been used in recent times to calculate the strength and robustness of concrete. The algorithm used for the prognosis of the concrete properties and their relationship with other constituents from the data has added ease to the prediction of strength. this study attempts to use advanced machine algorithms and categorization feasibility based on accuracy and implementation. This study is done by using gradient boosting, XGBoost, CAT-Boost, LightGBM, Random Forest Regressor, and AdaBoost Regressor to predict strength. This study categorizes the proportional analysis of advanced machine learning algorithms and earlier used algorithms for strength prediction and their effectiveness based on accuracy and the data features. Feature engineering shows the importance of features variable and their relationships using a different algorithm and filters out the less important features. the insights of using such concepts bring numerous possibilities for reducing the errors for better predictions. This study can demonstrate different possibilities for making the infrastructure sustainable and predictable by studying the mechanical properties and other factors affecting the compressive strength of concrete using Machine Learning.

Keywords: Gradient boosting algorithm, xgboost, cat boost, regressor, feature engineering, ensemble learning

Paper ID 189

A Review on Impact Assessment of 3D Printing Technology in the Field of Modern Construction

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Rapid urbanization necessitates the discovery of viable alternatives to conventional building practices. Traditional construction methods can no longer keep up with the growing demand for new structures and infrastructure. The development of environmentally friendly and cost-effective alternatives to conventional building practices has become an important objective. New technology and materials enable us to construct buildings that are more durable, less ex-pensive, and more productive. In addition, by employing multiple strategies, we can create a built environment that is more adaptable to our changing needs. In recent years, the use of 3D printing technology in contemporary building construction has increased in popularity. The time and money required to construct a structure can be cut in half due to the advent of 3D printing technology, which enables the rapid production of intricate structures and components. It is also used to create one-of-a-kind designs that would be impossible with more conventional construction methods. In this review, we are discussed about how 3D printing is currently being utilised in the construction industry, as well as its potential to save money and increase productivity, as well as its futuristic significance in the construction industry.

Keywords: Construction, 3D printing, Time saving, Work efficiency, Durability

Paper ID 191

Influence of Eggshell Powder and Silica Fume as a Partial Replacement of Cement on the Properties of Concrete

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Carbon dioxide (CO2) gas emissions from the cement manufacturing process have a harmful effect on the surroundings. The building sectors are looking for alternatives to cementitious material that can lower construction costs and also reduces the effect of cement production on the surroundings. Concrete made with waste products as a cementitious material uses less cement, which lowers overall building costs and reduces CO2 emission. This study's goal was to determine whether SF and ESP could substitute cement in the manufacturing of concrete. Cement was substituted by utilizing four percentages of eggshell powder (2.5%,5%,7.5%, and 10%) combined with four percentages of silica fume (5%, 10%,15%, and 20%) by weight of cement. In this investigation, the M40 grade of concrete was utilized. The workability, compressive strength, flexural strength, water absorption, and UPV test of eggshell and silica fume-based concrete were analysed. The outcomes showed that as the SF and ESP content rose, concrete's workability declined. 'Good' quality concrete was shown by the UPV test. Furthermore, the inclusion of ESP and SF in concrete enhances the material's compressive, and flexural strength. Also, it was discovered that the highest mechanical strength properties were reached by mixing 5% ESP with 10% SF in cement and as the contents of waste material increase, the mechanical strength decreases.

Keywords: Silica fume (SF), Eggshell Powder (ESP), Mechanical strength, water absorption, UPV

Paper ID 206

Effect of Sealed Curing on Perforated and Non-perforated Cenospheres Based Lightweight Cementitious Composites

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Fly ash cenospheres (FAC) are a by-product of thermal power plant coal combustion. It is lightweight, hollow spheres composed primarily of silica and alumina, with a trace of other elements. Fly ash cenospheres can help with sustainability in a variety of ways, such as conservation of resources, light-weight materials for construction, waste reduction, increased product performance, and lower carbon emissions. As a result, in order to fully benefit from cenospheres, it is required to investigate an ecological approach. The cenospheres' shells are porous by nature and are sealed by a thin layer of glazed-crystalline film. By chemically removing this coating, the small openings on the outer covering can be disclosed, perforating the cenospheres and allowing pathways for water to propagate into the inner cavity of cenospheres. The use of cenospheres as an internal curing ingredient for partially substituting cement in cement mortar has been investigated in this study. Two types of cement mortar specimens with the same dimensions, 50 mm × 50 mm × 50 mm, were cast by using perforated and non-perforated cenospheres as cement replacement up to 25% by the weight of cement Both perforated and non-perforated cenospheres specimens were cured under sealed curing. The specimens were tested for re-duction in density, Ultrasonic Pulse Velocity and compressive strength.

Keywords: Fly ash cenospheres, internal curing, reduction in density, destructive and non-destructive techniques.

Paper ID 212

Performance Influenced by Particle Size Distribution (PSD) of Composite Cement Incorporating Flyash (FA) and Ground Granulated Blast Furnace Slag (GGBFS) as SCMs

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Over-mining of natural resources by the cement manufacturing industries to meet the demand-supply chain has led to erratic concretization across the planet earth. This in turn has adversely resulted in fast-growing resource depletion and human-made toxic gas release into the atmosphere. Also, the ginormous quantum of industrial wastes viz. fly ash and slag, discharged by Thermal Power Plants (TPP), Steel Manufacturing Companies pose a dumping threat of polluting surface, and sub-surface water, and also the constraint of the limited disposal area. To overcome these problems, extensive research is carried out to maximize the partial substitution of pure Ordinary Portland Cement (OPC) with Supplementary Cementitious Materials (SCMs). However, such replacement dwindles the overall performance of resultant cement and mainly a reduction in strength gain. This paper articulates the performance influenced by the particle size distribution of Composite Cement comprising Ordinary Portland Cement (OPC), Stimulator (S), Fly-ash (FA) and Ground Granulated Blast Furnace Slag (GGBFS) trialed on certain key mechanical properties. The experimental results determined boosted strength gain at early as well as later curing ages with improved physio-mechanical properties of the composite binder. Also, a drastic reduction in anthropogenic gas emission can be achieved by replacing pure OPC with industrial wastes viz. fly ash and slag upto 60% combined substitution, thereby accomplishing overall sustainable development in construction activity.

Keywords: Particle Size Distribution, Composite Cement, OPC, Stimulator, Fly-ash, GGBFS, SCMs

Paper ID 241

An Experimental Study on The Effects of PVA, Jute & Recron 3S Fibers on Bendable Concrete Properties

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In engineering terminology, bendable concrete refers to Engineered Cementitious Composite (ECC), also called Strain Hardening Cement-based Composite (SHCC). Crack width control is tight in ECC, which is typically brittle. This composite is easy to mold due to its mortar-based composition. By using natural and artificial fibers such as PVA fiber, steel fiber, jute fiber bend-able concrete can be made more durable and produce narrow crack widths, as opposed to conventional concrete. These physical properties include compressive strength, split tensile strength, flexural strength test, and ductility. According to the observations, the addition of fibers improves the concrete's ductility and flexural strength. As a result of this study, bendable concrete has the potential to benefit construction in many ways, especially in terms of durability, sustainability, crack resistance and earthquake resistance. As well as fibers and fly ash can also be used for the production of an environ-mentally friendly construction material. Moreover, the high-performance construction materials selection process included comparing the cost of different concrete materials.

Keywords: Bendable concrete, Engineered Cementitious Composite (ECC), PVA Fiber, Jute Fiber, Recron 3S fiber.

Paper ID 265

Inclusion of Different Plastic Wastes as Construction Material in Concrete

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The aggravating global plastic waste crisis has made it imperative for many industries, including the construction industry, to prioritize the exploration of innovative ways to recycle and reuse plastic waste. The usage of plastics in concrete not only diverts this material from landfills and the environment but also offers a sustainable solution for the construction sector. This paper aims to discuss the recent research on the inclusion of plastic wastes in concrete that including the types of plastic waste used, their effects on the various properties in concrete and the environmental benefits. The plastic waste used in concrete includes poly ethylene terephthalate, polysterene, high-density poly-ethylene , low-density polyethylene and poly-propylene (PP) as partial replac-ments for coarse or fine aggregate in concrete mixtures. The addition of plastic waste to concrete has shown to enhance its mechanical and durability properties, as well as reduce the environmental impact associated with the disposal of plastic waste. The paper concludes that the addition of plastic waste in concrete has the potential to provide a sustainable solution to the problem of plastic waste disposal while contributing to the development of durable and high-performance concrete structures.

Keywords: Plastic waste, Concrete, Sustainability, Aggregate.

Paper ID 272

Mechanical Behavior of Geo-Polymer Concrete

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Geopolymer concrete is a novel material that has the potential to reduce the environmental impact of conventional concrete. However, its mechanical behaviour under different loading conditions is not well understood. This paper presents a comprehensive review of the experimental and numerical studies on the mechanical behaviour of geopolymer concrete, including compressive strength, tensile strength, modulus of elasticity, fracture toughness, creep, shrinkage, fatigue and impact resistance. The paper also discusses the factors that influence the mechanical properties of geopolymer concrete, such as curing temperature, mix de-sign, and exposure conditions.

Keywords: Flexural behavior, Reinforced Concrete, Geopolymer Concrete, Beams.

Paper ID 274

Experimental Characterization of Concrete Properties with Partial Replacement of Scrap Ceramic Tiles

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Natural resource availability is rapidly decreasing around the globe as a result of increased demand brought on by boosted infrastructure development as well as a rise in the demand for concrete. Concrete plays a vital role in the development of cities all over the Globe which creates harm to the environment. So far, a huge part of scrap ceramic tiles is used in disposal areas. Making use of these ceramic tiles wastes in concrete can somewhat reduce environmental concerns. This study's primary goal is to experimentally examine the feasibility to use the already utilized ceramic tiles i.e. Scrap pieces from the demolition of residences as an alternative for coarse aggregate in concrete. The procedure consisted of gathering, cleaning, and shattering scrap ceramic tiles and use as a partial substitute to coarse aggregate in M30 concrete and performing various tests such as the Compressive Strength test, Flexure Test, and Split Tensile Test. Ceramic aggregate was used in place of natural coarse aggregate in concrete at various weight percentages ranging from 0% to 100%. For all the mixtures, the water-to-cement ratio of 0.45 was taken into consideration. In comparison to ordinary concrete, the results demonstrated that using waste from ceramic tile manufacturing as coarse aggregate in concrete increased its compressive strength, tensile strength, and flexural strength to a certain limit and then decreases with an increase in % of scrap ceramic tiles. Additionally, the use of waste from ceramic tile manufacturing as a partial replacement for coarse aggregate in concrete may help lower waste disposal costs and increase the sustainability of the building sector.

Keywords: Ceramic tiles, waste reuse, coarse aggregate, feasibility, compressive strength, sustainability, demolished.

Paper ID 279

Brief Review on Cotton Plant Stalk Ash-Based Concrete

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It is well known that cement is the most expensive component of concrete. The entire construction sector is looking for an appropriate and efficient waste product that would significantly reduce the consumption of cement, as a result - lower the price of construction. This work discusses the various properties of concrete using cotton plant stalk ash (CPSA) as a partial replacement for regular Ordinary Portland cement (OPC). Works on the utilisation of agricultural wastes in concrete play a prominent role in the construction industry. To preserve the environment, CPSA can be partially replaced with cement. Utilising CPSA in concrete as a cement replacement enhances concrete performance. Also, it's an effort to help sustainability by utilising the solid waste produced in the agriculture sector. In this paper brief review of the properties of CPSA-based concrete was examined and discussed, from the various results its evident that the optimum addition of CPSA improves the properties of concrete.

Keywords: Cotton plant stalk ash (CPSA), Ordinary Portland Cement (OPC), properties of concrete

Paper ID 282

Development of Thin Joint Masonry using Recycled Mortar for Sustainability

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Rapid growth in the construction industry results in increased demand for natural resources like river sand, stone aggregate, etc., used in construction. As per Deccan Herald, the state of Karnataka, India demands about 45 LMT of sand for construction despite availability of 35 LMT. On the other hand, the construction and development boom in urbanisation results in large scale generation of construction and demolition waste (C&D Waste). Utilizing C&D waste as aggregates can provide sustainable alternatives and fill the gap between supply and demand. In this context, through this experimental program an attempt has been made to utilise C&D waste as an alternative to conventional sand in development of masonry mortar. An attempt is also made to assess the mechanical characteristics of masonry prisms with reduced mortar thickness. This results in reducing quantity of mortar, increasing pace of construction and ultimately reducing the cost of construction. The different combination of mortars and different types of prisms was attempted using replacement of m-sand with demolished concrete and masonry waste. The results explore that, all combinations of mortars studied can be suitably used in masonry construction. Stack bonded prisms exhibited higher compressive and flexural strength as compared to English bonded prism. Lastly, compared to conventional 12-15mm thickness of jointed masonry, thin jointed masonry resulted in reduced material consumption by 50%. In conclusion, reduction in utilization of natural resources and use of marginal materials, promote circularity in construction, resulting in reduced embodied carbon emissions and thereby improve the overall sustainability of the project.

Keywords: Thin joint masonry, Recycled Mortars, Concrete and Masonry waste, Circularity, Sustainability

Paper ID 292

Experimental Study on The Properties of Concrete by Partial Replacement of Cement with Eggshell Powder and Rice Husk Ash

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The replacing cement into concrete production from wastage products has shown trend in the construction industries due to its ability to minimize the ecological impact of cement production and removal of wastage substance. So this research provides an overview of wastage substances used as substitution are as RHA and ESP. Various test are performed such as compressive, flexural, workability, durability and specimens are prepared with different proportions. The grade used in this research is M30. The optimal strength and good quality results on replacement of ESP and RHA shows at 5%&15%.

Keywords: Rice husk ash (RHA), Egg shell powder (ESP), Cement, Compressive strength (CS), Flexural strength (FS)

Paper ID 294

Durability Assessment of Concrete Structures Using RCPT and RCMT

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Durability of the concrete is its ability to resist weathering action, chemical attack, and abrasion while maintaining its desired engineering proper-ties for the entire lifespan for which it is designed. It depends upon the environmental factors and the working conditions such as site conditions, workmanship etc. Durability of concrete is affected by various factors such as quantity of cement content used, water to binder ratio etc. Durability of concrete structure is of paramount importance as it is the durability which is required throughout its service life and decides the age of the concrete structure. Turning a blind eye towards the durability aspect results in high costs involved in repairs and modification of concrete structures, hence it is necessary to have an idea about the durability of concrete structures which makes assessment of durability quite significant. Ingress of chloride ions is one of the most significant factors which affects the durability of concrete structures. Chloride ion migration is dependent on the permeability of concrete. The chloride ions migrate into concrete and cause corrosion of steel reinforcement used. The corrosion products which are formed take up extra space in the concrete medium which results in spalling, cracking and ultimately failure of the concrete. The RCPT test are conducted in accordance with ASTM C 1202 and the RCMT test are conducted in accordance with NT BUILD 492. In the present study, a comparison of RCPT and RCMT tests and their relevance and usefulness in evaluating the durability properties of concrete is presented.

Keywords: Durability assessment, hardened concrete, RCMT, RCPT, Chloride ion migration.

Paper ID 298

Industrial Waste and their Influence on Mechanical Properties of Self Compacting Geopolymer Concrete

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Ordinary Portland cement (OPC) has predominant role as a binding material in the field of construction. Its production liberates enormous quantities of carbon dioxide (CO2) into atmosphere which results in increase in the levels of greenhouse gases and hence contributes to global warming. Further, with the rapid growth of industries in relation to the necessities, has major impact on the amount of waste by-products generation. In order to decline the environmental footprints, many researchers employed waste materials as an alternative material for cement and other natural materials. Though, many studies employed different waste by-products lonely in the production of geopolymer concrete (GPC) and reported different success rates. However, combination of different waste by-products in GPC is comparatively less. To address the same, the current study evaluates the performance of self-compacting GPC made from fly ash (FA), ground granulated blast furnace slag (GGBFS), and alkali activators. The test results revealed that the maximum compressive and split tensile strength of 55.1 and 5 MPa, respectively obtained at optimum contents of 10M NaOH, 50% FA and GGBFS with a curing period of 28 days. Such kind of studies are in need of hour to comprehend the better utility of multiple waste by-products in the production of effective GPC mixes.

Keywords: Fly ash, GGBFS, Self-compacting concrete, Geopolymer Concrete, Alkaline Solution, Waste by-products

Paper ID 305

Application of Dry Grinding as an Optimisation Tool for the Surface Area development in Geopolymer Cement Manufacture

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Geopolymer materials are mined or produced as industrial factory waste products. Geo-polymerisation always involves particle size reduction and reaction of these particulate materials into a single solid product at room temperature. Large stone particles are stable and unreactive due to a smaller surface area of the particles. To make them more reactive, the surface area of the reacting particles should be increased. This is achieved when the raw materials is finely ground in ball mills to very small particles. The current ball mills used in various mineral processing involve both use the Wet Milling Method and the Dry Grinding Method. The geopolymers have an improved strength development that I seek to optimise by providing a low-cost grinding method that has the capability to produce very high surface areas required for optimised strength development. A small hammer crusher was designed that crushes stones in their dry state. The maximum feed size of the crusher is 20mm, incoming material moisture levels < 5%. Airflows, fan sizes and sieve seize were selected and manufactured. These have special features of durability, wear resistance and low sieve blinding. Fineness (Blaine) and residues of the output was measured for various crushing speeds and sieve sizes. The dry crushing method was found to produce finer crushed product with lower residues on both the 45- and 90-micron sieves. The Dry grinding method was found to be 45% more efficient. It was also observed that it is more economic and requires less energy that the wet process.

Keywords: Surface Area, Reactivity, Residues, Compressive Strength

Paper ID 320

Durability Assessment of Green Cement Concrete Using Industrial Waste with Dry Geopolymer

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Green cement concrete is a type of concrete produced from industrial waste and dry geopolymer. This sort of concrete has the potential to have a lower environmental impact than traditional concrete production while also providing a more durable and cost-effective alternative. This article provides an experimental work of the use of industrial waste in green cement concrete, which is advantageous because it minimises the amount of garbage transported to landfills. According to the findings of this study, the use of industrial waste can lower production costs because it is typically less expensive than traditional resources, as well as the amount of energy required to manufacture the concrete because it is often lighter than traditional materials. Dry geopolymer is a sub-stance formed from a combination of silica, alumina, and calcium. Because of its great resistance to water and other factors, this material is ideal for use in green cement concrete. Furthermore, dry geopolymer green concrete is lighter than regular concrete, lowering the amount of energy required to manufacture the concrete. In general, green cement concrete made from industrial waste and dry geopolymer is an excellent way to reduce the environmental impact of traditional concrete production. It is also more durable and less expensive than typical concrete, making it an excellent solution for a wide range of construction applications.

Keywords: Geopolymer, Industrial waste, Alkaline activator, Sustainable, concrete

Paper ID 339

An Experimental Study on Concrete Made by Magnetic Water and Admixture

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Aim of this project is to increase the compressive strength & workability of concrete by using magnetized water. Concrete is made up of cement, sand, aggregate and water. Water is an important part of preparing concrete. It plays an important role in workability and the strength of concrete. A new technology known as magnetized water is used to improve the workability and Strength of concrete. For the creation of magnetic water, we prepare a model that contain air cooler motor, copper pipe, ring magnet. In this model the Water Cooler Motor has used with voltage of 180-230V and power of 18 watts. After that take a test on normal water and magnetize water from laboratory. Before the cube casting take test of material that we have to use is casting. To check the specific gravity of cement and then cast the cube in 4 batch that is normal water, magnetic water, normal water with admixture and magnetic water with admixture. After that work unmolding of cubes at next day and take for a curing. The test for cubes in 3 days, 7days and 28days for using universal testing machine. Reading of all cube testing is taken and compare which cubes having a higher strength. In this study, use of magnetic water increased the workability of concrete. Cubes containing magnetic water used for mixing and curing increased the compressive strength by 35-40% in 28 days compared to normal water cubes.

Keywords: Magnetic Field, Magnetic Water, Compressive strength, Generation of Magnetic field, Admixture, etc.

Paper ID 348

Compressive Strength of Mortar Made with One-Part Geopolymeric Binder

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One-part geopolymer concrete is an advancement over the conventional two-part geopolymer concrete. In this study, a geopolymeric binder was prepared in powder form containing slag as a precursor material, and sodium silicate and sodium carbonate as alkaline materials. Characterization of the developed binder was done with the help of a laser particle size analyzer and Scanning Electron Microscopy (SEM). The effect of heat curing and ambient curing was investigated in order to achieve target compressive strength in cement mortar. Results of this investigation revealed that mortar prepared from a one-part geopolymeric binder containing 90% slag and 10% alkaline material achieved more than 20 MPa 28-day compressive strength, which is significant for its utilization as bricks.

Keywords: Mortar, one-part geopolymer, slag, alkaline materials.

Paper ID 355

Thermo – Mechanical Beneficiation and Characterisation of Rice Husk Ash

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The high carbon footprint of cement urges to explore the pozzolanic potential of ashes obtained after burning of agricultural residues in cogeneration plants. In this regard, Rice Husk Ash (RHA) was obtained by controlled burning of rice husks in an industry set up. Thermo-mechanical beneficiation of the obtained RHA was done in order to make it compliant with the Indian and American codal guidelines. Physical, chemical and mineralogical characterisation of both the as-received and the beneficiated RHAs was performed. The results indicate that re-burning of RHA in the temperature range of 600–700ºC can be performed to reduce Loss-On-Ignition (LOI) below 5% without compromising the amorphous mineralogy of ash. Further, pozzolanic reactivity of the thermo-mechanically beneficiated RHA exhibited higher value compared to the pozzolanic reactivity of as-received RHA.

Keywords: Supplementary cementitious material, Rice Husk Ash, Loss on ignition, Pozzolanic reactivity.

Paper ID 357

Exploring Plastic Waste as a Viable Aggregate Alternative for Structural Concrete in the Indian Context

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Over the past few years, there has been a notable surge in global plastic consumption, leading to the accumulation of substantial quantities of plastic waste. To tackle this issue, recycling plastic waste has emerged as a viable solution, with the potential to create new materials like concrete or mortar. This approach offers both economic and environmental advantages. Numerous studies have been conducted to evaluate the performance of cement composites incorporating various forms of plastic waste as aggregate, filler, or fiber. This research paper explores the feasibility of using plastic waste as a substitute for environmentally-friendly aggregates in concrete production. It investigates the mechanical and physical properties of concrete mixes containing different proportions of plastic waste as a replacement for traditional aggregates. Furthermore, the research demonstrates that utilizing plastic waste as an aggregate replacement can significantly reduce the demand for natural aggregates, thereby addressing the escalating problem of plastic waste management. The paper concludes that incorporating plastic waste as an alternative aggregate in concrete production can contribute to a more sustainable construction industry while effectively tackling the plastic waste issue. Moreover, this research has the potential to open up new avenues for the production of environmentally-friendly concrete.

Keywords: Concrete, Aggregate replacement, Plastic waste, Sustainable construction

Paper ID 373

Experimental Study on Strength Behavior of M30 Grade Broken Tiles Waste Concrete

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In the design of concrete mix, cement, fine aggregates and coarse aggregates are using for a past long period of time, that involve essential role in designing of a particular grade of concrete. But now a days there is a lack in coarse aggregates So, some of alternate new materials which are choose based on locally available of low-cost materials are introduce for partial replacing of coarse aggregates to obtain same strength as that of the basic materials. In this research work the analysis of partial replacement of coarse aggregate with 0%,5%,10%, 15%, 20%, 25%, 30%, 35% and 40% of broken tiles wastes with maximum size of 20mm used in the production of M30 a water-cement ratio of 0.45 is used. Experimentally analysis is conducted on fresh concrete for workability and hardened concrete tests conducted like a compression test and split tensile to evaluate the concrete strength, at different stages of curing time periods of 7 and 28 days. From the results obtain that shows the water-cement ratio improves the workability of the concrete, with the addition of ceramic wastes broken tiles materials upto 30%, this concluded that partial replacement of ceramic tiles waste despite performance in concrete decreases with increasing of replacement of ceramic wastes broken tiles materials.

Keywords: M30 concrete, waste floor tiles, compressive strength, split tensile strength.

Paper ID 427

BIM-Based Integrated Approach for Design and Construction Planning of Building Projects

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The complexity of construction projects has increased significantly, leading to difficulties in their management. To address this, Building Information Modeling (BIM) has emerged as an integrated process that is widely adopted in the Architecture, Engineering, and Construction (AEC) industry. BIM allows for the modeling and analysis of both design and construction aspects of a building in an integrated manner, thereby minimizing changes during the construction phase. This study aims to conduct a comprehensive literature review and identify research gaps in integrated design-construction planning, while also developing a 3D model of multiple domains of a construction project. Furthermore, the study aims to perform structural analysis of the 3D model, resolve any clashes that arise from multiple domains, and generate a 4D scheduling and 5D costing model for an economically feasible project. Structural analysis was performed using STAAD Pro software, and clashes were identified and resolved using NAVISWORK software. The final clash-free integrated model was used to estimate accurate 4D scheduling and 5D costing of the project in a 3D environment. Structural analysis was performed for all 3D models in an integrated manner, demonstrating the effectiveness of BIM in this regard. The proposed methodology focuses on the modeling and analysis of both design and construction aspects of a building in an integrated manner using BIM, which minimizes changes during the construction phase. The study demonstrates the effectiveness of BIM in reducing redesigns in projects by enabling the resolution of all issues visually in the design phase.

Keywords: BIM, Integrated design-construction planning, Clash detection and resolution.

Paper ID 464

A review on "Effect of partially used Sustainable Sea Shell Powder and Alccofine in concrete production"

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In order to lessen reliance on natural resources, concrete technology advances are currently focused on gaining sustainable concrete alternatives. Re-cycled materials made from industrial waste and byproducts make up a large portion of an alternative materials utilized in the green concrete. Due to the technological revolution they are bringing to the discipline of civil engineering, supplementary cementitious materials (SCM) such as Alccofine and Sea Shell Powder are becoming more and more popular in the building industry. In order to develop a useful Alccofine and Sea Shell Power, this work looked at a variety of research publications. This essay's goal is to summarize and discuss the mechanical characteristics of alccofine and sea shell powder, particularly their compressive strength and other workability and durability characteristics. In the construction industry, SCM, or supplemental cementitious materials, can be used in place of cement to cut down on carbon dioxide emissions, which are linked to climate change. Finding sustainable alternatives for construction materials is the aim of this study. According to the numerous articles compiled, Alccofine 1203 can be used at the ideal dose between 8% and 10%, and the ideal amount of seashell powder serves as 30%, resulting in an average strength of 30 N/mm2. Utilizing this concrete reduces waste production and carbon emissions by reducing the requirement for Portland cement.

Keywords: Green Concrete, Supplementary cementitious material (SCM), Alccofine, Sea Shell.

Paper ID 467

Use of Coconut Coir Fibre in Limestone Calcined Clay Cement (LC3) Concrete

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Concrete is increasingly being used in the industrial sector. CO2 emissions are increasing as a result of the use of concrete. Limestone Calcined Clay Cement (LC3) is one such alternative discovered by researchers to reduce CO2 emissions and safeguard the environment from being polluted. LC3 is ternary blended cement prepared by 50% clinkers, 30% calcined clay, 15% low grade of limestone and 5% gypsum. Agricultural waste disposal, such as coconut coir fibres, also pollutes the environment. So, in this study, M25 grade concrete is made by combining LC3 with Coconut coir fibre. Coconut fibre percentages such as 0.3, 0.6, 0.9, 1.2, and 1.5 were utilized to estimate compressive and flexural strength on both LC3 and normal concrete. The result shows that using 1.2 % coconut fiber has better strength properties compare to other mixes. The use of coconut fibre decreases the workability of concrete. The microstructure of M25 grade of concrete was observed by Scanning Electron Microscopy (SEM) analysis.

Keywords: Coir fibre, Limestone, Calcined clay, Compressive strength, Flexural Strength.

Paper ID 468

Utilization of Unused Old Cement in Construction Materials

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India is the second biggest producer and consumer of cement with the generation of 380-390 million tons in the financial year 2023, it is expected to add 80 million tons of cement by the year 2024 due to expected demand in housing and infrastructure development. According to Indian Brand Equity Foundation past five years data it was estimated, approximately every year 2-3 million tons of cement produced is unused. The production of cement is highly carbon intensive, if such a huge amount of cement remains unused and disposed unscientifically may lead to environmental issues such as hindrance to ground water recharge, non-degradable landfills, obstructing surface run-off etc. On the other hand, a considerable quantity of construction material, viz, pavers, low strength and non-structural concrete, non-load bearing masonry, etc., does not require very high strength material for construction. Thus, an attempt is made to utilize and evaluate the effect of unused old cement in construction materials like paver blocks and mud concrete blocks. Materials were characterized for its basic physical properties and compared with control specimen. Old cement samples were also subjected to microstructure analysis using scanning electron microscopy technique. Box shaped paver blocks were developed and tested for their compressive strength. Initial rate of absorption, water absorption, density of blocks and strength parameters were evaluated for mud concrete blocks. Results indicated a reduction in strength of concrete by more than 30% and 50% for 1-year and 2-year-old cement respectively. Also, loss of ignition value was observed in cement due to ageing. Application of paver blocks was found to be feasible in light and non-traffic roads.

Keywords: Unused old cement, Paver blocks, Mud concrete blocks.

Paper ID 472

A Review on Different Processing Methods to Improve Pozzolanic Properties of Agricultural Waste Ashes

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Several agricultural products are discarded as waste every year; Utilization of this wastes becomes a socio-economic solution for agricultural waste disposal. Because of the pozzolanic properties exhibited by these types of waste material, they took great advantage of utilizing them as a partial replacement for cement in concrete and mortars. Both normal-strength and high-strength concrete is manufactured by incorporating various agricultural-based pozzolanic materials majorly it includes Rice husk ash, Palm oil ash, Corncob ash, sugarcane bagasse ash etc., The implementation of pre-treatment methods before combustion greatly enhances the chemical, physical and mechanical properties of pozzolanic materials. Acid treatment becomes the most satisfiable pretreatment method for agricultural-based pozzolanic materials. The pozzolanic activity can be accessed by various direct and indirect approaches, like electrical conductivity and chaplle activity. Understanding the pozzolanic activity and hydration mechanism of cement with pozzolanic material leads to the development of structurally sound concrete.

Keywords: Pre-treatment, mineral admixture, testing of pozzolona, pozzolanic activity.

Paper ID 504

Use of Reclaimed foundry sand (RFS) as fine aggregate in Mortars and Concrete

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Annually around 100 MT of sand has been expensed by metal casting industries across the world. This results in generation of huge quantity of used sand often addresses as reclaimed foundry sand or waste foundry sand. This sand is disposed after multiple use. However, this disposed RFS exhibits similar composition to that of conventional sand and can be used as construction material. Currently, around 28% of disposed RFS are being used in building construction related applications, while the rest of material is disposed as landfill, causing impacts on environment and ecological system. Natural sand is widely used in constructions, and its requirement is increasing continuously. Due to lack of availability of Natural Sand, manufactured sand is produced from quarries and is widely used in construction as an alternative to river sand. With extensive mining of granite quarries, cost of M-sand is also escalating. These concerns of environmental impact, availability and cost of basic materials have led the direction towards utilization of recycled/ industrial waste materials. These alternative fine aggregates are silica enriched and inert which can be used as partial or complete replacement to sand in mortar or concrete. In this article, Reclaimed foundry sand (RFS) is used as alternative to conventional fine aggregate. Chemical, mineralogical properties of RFS is explored and compared with M Sand. Micro-structure investigation indicated silica concentration in RFS was of the order 72%. Mechanical property of Mortars and concrete made with partial replacement of M sand by RFS is also investigated. Compressive strength of mortars and concrete samples were comparable when RFS was used as an alternative to M sand when the replacement was limited to 20% and 40% for mortar and concrete respectively. Shear bond strength of masonry triplets was in the range of 0.14 to 0.18MPa for mortars made with 20% replacement of M sand by RFS.

Keywords: Reclaimed foundry sand, M sand, mortar, compressive strength.

Paper ID 535

Analysis of Graphene Based Composite Used in Concrete: A Review

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In recent few decades global climate change become catastrophe and this problem is rising day by day. Out of many sectors the construction sector is alone responsible for at least 10% for total emission of carbon into the atmosphere. To provide the durability, strength, versatility during any construction work concrete is must. This literature review mainly focuses on performance of cementation material along with the Graphene oxide. The principle material which affects the concrete most is cement, thus in response to growing more sulphur dioxide, nitrogen oxide and carbon monoxide like greenhouse gases the research community started finding innovative alternative for cement composite with greener material and also considering significant improvement of concrete properties. In recent times new material is taken into consideration for partial replacement of cement and that material is known as Graphene. The research for this study commenced with an in-depth review of trustworthy publications, papers, books, entities, and current studies on cement based concrete using graphene oxide (GO). To find the best way to improve overall performance so that the construction industry could design buildings or any structure with the best quality of basic material, a statistical summary of the prior researches and a detailed discussion added to this review in regards to workability, durability, mechanical properties, and microstructural properties.

Keywords: Concrete, Nanomaterials, Graphene, Graphene oxide, Durability.

Paper ID 547

Enhancing the Durability of Concrete with Agricultural Bagasse Ash

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Concrete, a prime material used in civil construction because of its high compressive strength, suffers a disadvantage as it is attacked by chloride, sulphate etc. In this paper, an attempt is made to overcome these problems as well as to reduce the environmental damage in the production of cement by replacing cement to the extent possible with agricultural waste bagasse ash. Detailed experimental studies are conducted with various levels of replacement of cement in concrete with sugar cane bagasse ash designed for M25 grade. While the strength of concrete has been maximum with 5% of bagasse ash, upto 15% of bagasse can be used to meet the targeted strength. Conventional concrete is attacked in aggressive environment is mainly due to presence of excess lime liberated in the hydration of cementitious phases of Portland cement. Bagasse ash which contains reactive silica can very well advantageously use this lime to produce more cementitious compounds as well as to reduce excess lime to enhance durability of these compounds. The results have shown that not only the compressive strength increases but also the tensile strength and in fact the percent increase in tensile strength is more than the increase in compressive strength. Concrete with bagasse ash has lower water permeability than concrete without bagasse ash which helped to penetration of harmful effects of chloride, sulphate and alkali leading to much lesser effects of concrete in their presence. However, the effects of sulphate and alkali are not completely eliminated with replacement of cement with 15% bagasse ash but the adverse effects are lower than conventional concrete. Higher swell and shrinkage of concrete with bagasse ash in the presence of these chemicals than the same without these chemicals have been explained by microstructural changes with them. Thus, from the durability point of view 15 % cement can be replaced with bagasse ash used.

Keywords: Bagasse ash, Compressive strength, Durability, Flexural/ strength, Microstructure.

Paper ID 554

Durability Studies on Self Compacting Concrete containing Sepiolite Powder and Recycled Coarse Aggregates

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The properties of self-compacting concrete made from recycled coarse aggregate and cement binder alternatives, including fly ash and sepiolite powder, are the focus of this experimental investigation. Ternary blended SCC mixes are made in a variety of configurations according to IS 10262-2019 and EFNARC specifications. Various tests, including the V-funnel, L-box test, J-ring, and slump flow, were performed to examine the new properties. To evaluate the SCC's mechanical qualities, a compressive strength test was performed, and the material's resistance to carbonation and sulphate-chloride was measured. The results show that the workability required by EFNARC can be achieved by adding sepiolite and increasing the fly ash content in the SCC. Up to a particular level of replacement (10% sepiolite and 20% recycled aggregate), the mechanical parameters of ternary blended SCC were superior to those of the control SCC. When cement is swapped out with sepiolite powder, SCC has improved durability. Carbonation depth was shown to increase as there were higher replacement amounts of sepiolite powder and the corresponding re-cycled aggregates. The sulphate and chloride resistance of SCC was also significantly aided by the incorporation of up to 15% sepiolite and 30% recycled aggregates.

Keywords: self-compacting concrete, sepiolite powder, recycled aggregates, compressive strength, carbonation, sulphate-chloride resistance.

Paper ID 583

Group Indexing of Fly Ashes using Unsupervised Learning and Fuzzy Clustering Techniques

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From long, fly ash is a most sought-after material in the construction industry. It is used as cementitious material as a supplement (SCM) to ordinary Portland cement (OPC) concrete as a replacement for cement. Recently, its usage as a geopolymer cement while developing geopolymer concrete (GPC) mixes has been well documented in bibliography. Apart from this, fly ash has found wide utility in every other realm of civil engineering as a material to reckon with. Fly ashes have been traditionally classified in to two groups Group-C and group F as per ASTM. BIS has classified as class F and class C, and class P. These categorizations are hinged on chemical constituents and their contribution as a constituent material in concrete matrix. This paper presents the application of unsupervised machine learning techniques namely, k-means, k-medoids and fuzzy c-means algorithm have been applied to classify fly ashes on a data set of 400 instances. The chemical composition like SiO2, Al2O3, Fe2O3, CaO and LOI have been considered as fly ash attributes. The data instances are clustered optimally into three groups. K-means and k-medoids algorithms were able to cluster with minimal overlapping with similar number of instances of each group. These optimal numbers of clusters were found using elbow method. However, fuzzy c-means algorithm grouped differently by attaching a fly ash data instance to a appropriate group with higher degree of belongingness of each data instance to a particular cluster. From the results obtained, the clustering rendered by fuzzy logic approach proved to be optimal as it placed the instances in groups affixing them with degree of belongingness. Based on this clustering, group characteristics are also elicited.

Keywords: Fly Ash, Machine Learning, K-means, K-medoids, R Programming, Clustering.

Paper ID 592

A Short Review on 3D Printing in Construction Perspective

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Construction sector is the largest employer provider in the world and with a high labour demand. Low productivity and few technological advancements have affected the construction sector for few decades. In recent times, three-dimensional printing an automated method with layer by layer control has developed. Over the past decades, three-dimensional printing has changed along with new technology advancements in productive manufacturing. 3D printing has been done for design optimization and provide changes over traditional production techniques. To compete in the market that is rapidly changing, all industry should adopt new development. The same applies to the construction sector. As a result, the construction sector is paying close attention to 3D printing technology as a new strategic challenge and also adopted. Reviewing 3D printing is the paper's primary goal through automation attempts in construction perspective. In several developing countries, prefabricated construction methods have gradually implemented the practice of mixing and pouring concrete on site.

Keywords: Three-dimensional printing, Construction sector, Prefabricated construction, Automation.

Paper ID 610

Experimental study on the Substitution of Natural Sand with M-Sand and Incorporation of Steel Fibers in Concrete

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In recent years, gigantic structures like multi-story buildings, dams, bridges, and nuclear plants are constructed with high-strength concrete. How-ever, concrete is brittle and has a lower tensile strength. When exposed to high temperatures, concrete loses some of its mechanical properties. Fibers were added to the concrete to lessen brittleness and enhance these mechanical proper-ties at high temperatures. Natural sand is scarce and has negative environmental effects when it is taken out of riverbeds and other sources. In order to address these issues, researchers have looked into alternatives like manufactured sand (M-Sand). To ensure long-lasting and sustainable constructions, improving the mechanical qualities of concrete has also been a priority. In this study, the performance of concrete was examined after addition of steel fibres and M-Sand are added in place of natural sand. In this work M75 grade concrete was used. Various amounts of m- sand(0%, 25%, 50%, 75%) was used in place of natural sand. From this study concluded that M-sand is particularly cost-effective when utilised to achieve increased strength, and replacing 50% of M-sand results in greater strength. The tensile strength of concrete is also increased by the insertion of steel fibres.

Keywords: High strength concrete, manufactured sand, steel fibers.

Paper ID 622

Incorporating Demolition and Construction Waste as Reused Concrete Aggregate

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In a lot of countries, including India, the issue of demolition and building waste is an important issue for the environment. The improper disposal of such waste can lead to pollution of land, water, and air, as well as contribute to the depletion of natural resources. Every year demand of conventional aggregate is increasing at a rate of 6.2%. To address these problems, various countries have implemented recycling practices for construction and demolition waste. Recycling construction waste can help reduce the burden on the environment by reusing materials and minimizing the need for extracting and producing new re-sources. This research paper study is based on recycling of construction waste to reduce stress on environment. The primary aim of study different properties of recycled concrete aggregate and perform various test to analyze its properties. Relating recycled aggregate concrete to conventional aggregate concrete, the strength obtained is 10% to 15% lower. Research studies on recycled concrete aggregate (RCA) focus on assessing its properties to ensure its suitability for various applications. Some of the properties that are typically evaluated include compressive strength, water absorption, density, abrasion resistance, and durability. These tests help determine the quality and performance of RCA and com-pare it to conventional aggregates. Studies showed conventional aggregate can be replaced up to 30% to 50% by recycled aggregate. This approach not only reduces the environmental impact but also offers potential cost savings, as recycled aggregates are often less expensive than conventional aggregates.

Keywords: Disposal, Demolition, Recycled Concrete Aggregate (RCA), conventional aggregate

Paper ID 626

Effect of Bio-cementation process on light weight bio inspired Concrete

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Nowadays, the process bio-cementation is widely used in field of Civil Engineering. It is acknowledged as a green choice to use bio-cementation as a bonding agent in building materials. Calcium carbonate for use in construction is produced by the bio-cementation process using microorganisms. The bio-cementation technique creates a binding in building materials based on a process called Microbial Induced Calcium Carbonate Precipitation (MICCP). MICCP is catalysed via cementation and urea hydrolysis. By using urease enzyme, ureolytic bacteria produce precipitated CaCO3. Calcium ions and carbon dioxide from urea combine to generate calcium carbonate. Bio-cementation process will also help to enhance the compressive strength by reducing water permeability. Bio-cementation is proved to be an eco-friendly technology in the various fields of engineering. An attempt was made to use the coconut shells as a coarse aggregate in concrete. The effect of bio-cementation process on bio inspired lightweight concrete was observed. The considerable increment in the mechanical properties were found when compared to normal concrete.
Keywords: Bio-cementation, MICCP technique, Urea hydrolysis, Coconut shells, Microbial solution, Bio-concrete.

Paper ID 643

An Experimental Investigation on Compressed Stabilized Earth Blocks [CSEBs] Reinforced with Coconut Fiber and Partially Replacing Cement with Egg Shell Powder [ESP]

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The construction industry has a significant impact on both the environment and human well-being. However, the use of conventional construction materials has led to unfavorable outcomes including environmental contamination, depletion of resources, and elevated energy consumption. Consequently, there is a growing need for sustainable and eco-friendly alternatives to traditional building materials. Compressed stabilized earth blocks (CSEBs) have emerged as a potential solution to this problem, being both environmentally friendly and cost-effective. An experimental investigation was carried out to evaluate the capability of CSEBs. The study analyzed four variations of CSEBs, including conventional CSEB, CSEB with coconut fiber, CSEB with eggshell powder (ESP), and CSEB with both coconut fiber and ESP. The research focused on compressive strength, water absorption, and durability of CSEBs, comparing their performance with each other. The study concluded that the in-corporation of coconut fiber and ESP enhanced the performance of CSEBs, leading to higher strength, reduced water absorption and greater durability. Furthermore, using CSEBs with coconut fiber and ESP can significantly reduce carbon emissions and promote sustainable development. This research's findings can provide valuable insights for architects, engineers, and policymakers seeking to use eco-friendly building materials for construction projects.
Keywords: CSEB, Coconut fiber, Eggshell powder, Compression test.

Paper ID 567

An Experimental Investigation of Untreated and Treated Corncob Ash Concrete

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Cement is used for most of the construction work in the world. The 15 consumption of cement needs to be reduced. Cement can be replaced with additional cementitious materials such as agricultural and industrial wastes such as fly ash, GGBS, Corncob Ash, Wheat straw Ash etc., to reduce cost of construction. In this present study, Corncob Ash (CCA) is used as replacement for cement at various percentage. Compressive Strength of M20 grade concrete is tested for various percentage of Untreated CCA and Treated CCA of 5%, 10%, 15% and 20% by weight of cement is replaced and the results compared with the conventional concrete. Test results obtained at 28 days shows treated corncob ash replacement at 5-10% of replacement have better compressive strength compared to untreated corncob ash and conventional concrete. The optimum strength value of 29.74 MPa occurs at 10% replacement of treated CCA. The use of treated corncob ash in concrete proves to be economical compared to conventional concrete.

Keywords: Corncob ash, Pretreatment.

Structural Engineering

Paper ID 030

Effect of Length and Percentage of Dispersed Steel Wire on Compressive Strength of Concrete

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Increasing the bearing capacity of concrete as well as improving some mechanical properties in concrete such as resistance to impact, reducing cracks, increasing tensile strength, and increasing the lifetime of use of concrete with different fibers such as Dramix steel fiber, glass fiber, synthetic fiber, natural fiber, and so on is one way of reaching these goals. However, in this paper, Dramix steel fibers have been replaced with steel wires of a diameter of 1 mm. The steel wires are then cut into straight steel bars and added to concrete samples so that the compressive strength of the concrete samples may be tested. The percentage of steel wire included in the concrete varied from 0% to 3% in lengths of 30mm, 40mm, and 50mm. The lengths were measured in millimetres. According to the results of the experiments, the optimal combination of steel wire length and percentage is 30mm long fibers with a steel wire percentage of two percent. The compressive strength of the material being tested increased significantly, increasing from 27.83 MPa to 32.8 MPa as a result of this change in length as well as quantity.

Keywords: mechanical properties, steel fiber, steel wires, compressive strength, concrete.

Paper ID 050

Effect of External Ring Stiffener and GFRP Strip Wrap-ping on the Buckling Behaviour of Cold-Formed Steel Tubular (CFST) Column

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Circular Hollow Sections are round tubular steel sections that are used for a variety of purposes in civil engineering. They are usually available in the market as hot-rolled or cold-formed sections. Hot-rolled circular hollow sections are usually employed for structural purposes such as columns, struts, ties, etc. Cold-formed sections are usually used as purlins and as framing for lightweight building construction. The Cold-Formed Steel Tubular column was tested for failure under axial compression. The parameters varied in this study are the slenderness ratio (24, 26, 28 and 30), the diameter of the tubular section (D1 = 76.2 mm and D2 = 3.3 mm) and retrofitting techniques (External Ring Stiffeners and GFRP strip wrapping). All the specimens were tested for failure by loading using Universal Testing Machine. The failure mode and load – deflection behaviour was studied in detail. From the study, it was observed that the control specimen without ring stiffener and GFRP strip wrapping with slenderness ratio 24 are found to be stiffer than other slenderness ratios. The increase in the D/t ratio from 31.7 to 38.1 increase the load - carrying capacity and overall behaviour of the tubular column. The analytical results are close to the experimental, but slightly less than the experimental results because of the rigid body connection.

Keywords: Cold-formed steel, tubular column, glass fiber strip, ANSYS, failure mode.

Paper ID 054

A Study on Transient and Modal Analysis of A GFRP Bridge Deck Under the Action of Heaviest Main Battle Tank Currently Available in India (T-90S Bhishma)

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To enhance the mobility of the military forces to the impregnable areas and also to provide a temporary access for rescue force to the disaster area when the existing landline of communication system is damaged or destroyed, light weight portable bridges are very much useful. Nowadays, Fibre reinforced polymer (FRP) composite becomes an integral part of the construction industry. But for most of the cases, use of FRP is restricted in combinations of FRP and conventional materials or in retrofitting areas. The relative lightness and high strength to weight ratio makes it possible to enhance the portability of the bridges made by FRP only. The use of such materials for major load-bearing members are increasingly being promoted because of its superior material properties like high resistance to fatigue, corrosion free, enhanced durability, huge heat resistance, lower maintenance and life-cycle costs etc. Present study includes the modeling and simulation analysis of FRP bridge deck slab subjected to moving load of heaviest battle tank currently available in India (T-90S Bhishma) by using ANSYS 19.2 FEA software. ANSYS 19.2 FEA software is selected to simulate the proposed design model bridge in the ANSYS Composite PrepPost (ACP). This research examines the performance of a FRP bridge deck in terms of modal and transient analysis. Glass Fiber Reinforced Polymer (GFRP) is being used as a primary material for this bridge deck.

Keywords: GFRP Bridge deck, Modal analysis, Transient analysis, Tank load.

Paper ID 063

Correlation Analysis Between Seismic Response of Primary Auxiliary Building and Ground Motion Intensity Measures

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The auxiliary building (AB) plays a crucial importance in the safety operation of nuclear power plants (NPPs). This study evaluates seismic performances of the primary auxiliary building in the Korean Standard (KS) nuclear power plants (NPPs). The numerical model of the AB structure is developed using a series of multi-layer shell elements, in which nonlinear material properties of concrete and reinforcement are considered. A set of 90 ground motions is employed in time-history analyses for evaluating the seismic performance of the structure. Floor accelerations and displacements of the structure are monitored as engineering demand parameters (EDPs). Statistical indicators including the goodness of fit (R2), standard deviation, and practicality are employed to evaluate the correlation between EDPs and 21 considered earthquake intensity measures (IMs). The results show that the strongest correlated IMs are $S(T1)$, $Sv(T1)$, $Sd(T1)$, followed by ASI, SMA, EPA, and PGA.

Keywords: Primary auxiliary building; multilayer shell element model; seismic response; time-history analysis; earthquake intensity measure; correlation analysis.

Paper ID 067

An Investigation of The Behaviour of Composite Materials Made of Aluminium, Metal, and Carbon with Titanium Di-Boride Reinforcement

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They may consist of at least two distinct parts, such as a reinforcement and matrix constructed of different materials, which allows them to have more desirable properties than a single material, such as greater ductility, greater specific strength, and lighter weight. A variety of metals, fibres, glass, organic substances, or ceramics can be seen in materials like Metal matrix composites (MMC), for instance. They also gain from the composites' expanding mechanical and physical characteristics because of the matrix's volatility. The primary objective of this work is to evaluate the behaviour of a carbon and titanium diboride-reinforced aluminium metal matrix composite under a range of stresses. In this work, a FEM tool (ABAQUS CAE) was used to compare two 60 m* 60 m* 60 m composite models with 20% carbon and TiB2 reinforcement volume proportions. The most prevalent substances, including aluminium, titanium, magnesium, and carbon, might be used as reinforcing materials, with aluminium serving as the matrix and ductility. The basic goal of the tool is to simulate an aluminium metal matrix composite (AMMC) with various loads, different Young's moduli, different Pois-son ratios, and different yield stresses, and to extract the findings as various stresses and strains. According to the test results, AMMC that has been reinforced with carbon has a higher young's modulus.

Keywords: Tensile power, ductility, Poisson's ratio, the Young's modulus, Laminates, Aluminium, Metal Matrix Composites, and Mechanical and physical characteristics.

Paper ID 080

Compressive Strength Evaluation of Reinforced Concrete Beams with a Newly Designed Magnetorheological Rebound Hammer by Core and UPV Test

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This study's main objective was to assess a newly built magnetorheological hammer for use in core and ultrasonic probe velocimetry (UPV) testing to determine the compressive strength of RC. By reusing or recycling existing materials, reinforced concrete has been found to reduce building costs and have a smaller negative impact on the environment. On the other hand, well-established techniques for determining material strength without breaking it include magnetorheological hammer and core testing. This study set out to determine the compressive strength of RC using the suggested methodology and compare the results to those attained using 150 mm core specimens. To do this, three different types of concrete were created. OPC, river sand, and natural aggregate (crushed granite) were used to make concrete. These concrete mixtures, which contained aggregates no larger than 20 millimeters, were poured in order to evaluate a newly designed magnetorheological design using UPV, core, and hammer methods. Using this multi-faceted strategy, correlations between UPV, core testing, and magnetorheological (MR) hammer were also obtained. These results are more encouraging than those from the rebound hammer test, which showed that it was impossible to anticipate with any degree of accuracy the compressive strength of the RC.

Keywords: Reinforced Concrete, Industrial waste, Ultrasonic, Environment, Compression

Paper ID 089

Investigation of Crack Propagation of Fly Ash Based Geopolymer Concrete using Digital Image Segmentation Approach

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Fly ash, a byproduct of burning coal, is usually used as a supplementary cementitious constituent in the creation of concrete. It has been discovered that using fly ash in a concrete has a number of advantages, including improved workability, decreased permeability, and greater strength. Using image processing techniques, this study seeks to regulate the ideal amount of fly ash in the concrete mix in respect to crack propagation. The study entailed analysing concrete cylinders samples in the lab with dimensions of 150 mm x 300 mm that contained different amounts of fly ash- 5%, 15%, 25%, 30%, 40% and then 50% by weight of cement. A total of 120 concrete cylinders were prepared and compressive tests were performed, and the photographs of cracks under proper lighting conditions were taken to analyze using image processing. Different parameters were used for study: Otsu threshold value, size of area of interest of crack, and fly ash content. The Otsu Threshold Image Segmentation was utilized as a binary thresholding method to detect the crack from the images. The parameters varied according to the histogram of each crack image which were segmented by minimizing the variance on each class. With these analyzed parameters, the results signify that the percentage of fly ash content was achieved to be within 25% - 30% of cementitious materials to fall in the category of “low crack class”. The granularity/fineness of fly ash also verifies the results as the particles fill up the space providing strength till optimum substitution, after a while the entire concrete mix loses its strength as the fly ash is superabundant.

Keywords: Fly Ash, Crack Propagation, Image processing, Image Segmentation, Geo Polymer Concrete

Paper ID 108

Performance of Concrete at Elevated Temperatures: A Review

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Concrete is the most common material used in the construction which is composed of cement, coarse aggregate, fine aggregate, water and admixtures. However, when exposed to elevated temperatures such as fire, concrete undergoes significant changes in its properties, which can result in reduced performance or even failure. This review provides an overview of the effects of elevated temperature on concrete, including thermal cracking, loss of strength, and spalling. The mechanisms of these effects are discussed, along with the factors that influence them, such as the composition of the concrete mix and the rate of heating. Various strategies to enhance the fire resistance of concrete are also presented, including the use of supplementary cementitious materials and fibers, as well as coatings and surface treatments. The review concludes with a discussion of the current state of knowledge in this field and areas for future research.

Keywords: Fire, Concrete, Durability, Compressive Strength, Elevated Temperature

Paper ID 118

GFRP Strengthened Timber Filled Concrete Composites under Axial Load

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Timber is one of many natural products used around the world for a variety of purposes. It is used not only for the construction of small buildings, but also for the construction of large buildings. Improving this property of the Timber-based products can make them more reliable and competitive in the construction sector. This is where the importance of Composite comes into play. One such new composite is known as Timber Concrete Composite (TCC). This project focuses on the study of a sustainable design solution in case of compression members by making use of the advantage of composite action. This paper experimentally investigates the effect of Glass Fibre mesh (GFM) as strengthening material for timber on the axial capacity of Timber filled concrete Composite (TFCC) with different timber cores. The TCC specimens were de-signed with a single sized infill in which locally available Anjili and Mahagony timber is selected. The structural response including failure, ultimate capacity, displacement behaviour, absorbed energy and axial stiffness were evaluated and discussed. The parameters considered are wrapping configuration and number of wrapping layers. It was found that the use of timber as a core in concrete helps lightening the weight of the composite. The total capacity of the compo-site depends upon the material properties of the core timber and the grade of concrete employed in the cylindrical composite specimens. This concept of improving the performance of axially loaded members incorporating a timber core helps in contributing light weight to structure and reducing the impact of consumption of cement.

Keywords: Timber Concrete Composites, Timber filled concrete, Timber core, strengthening, FRP.

Paper ID 127

Performance of High Strength Concrete Prepared with Fresh and Seawater

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In the current work, the structural behaviour and strength characteristics of High strength concrete (HSC) made using fresh and salt water were examined. As per the codal provision, seawater is not recommended for mixing of concrete due to its high concentration of chloride in seawater caused corrosion of steel. Additionally, the worldwide problems posed by freshwater scarcity imply that using seawater in concrete mix will become important in the future. In OPC-based concrete, rice husk ash (RHA) and metakaolin (MK) are employed as cement substitutes in order to reduce CO2 emissions during the calcination of cementitious materials and to improve the mechanical qualities. HSC made using both fresh and salt water. For various curing periods, concrete qualities including compressive strength, bond strength, and rupture modulus were investigated. Based on the experimental results 10% RHA and 10% MK (binary blend) used fresh water and seawater mix concrete showed better performance on various strength properties when compared to control mix. To study the structural behaviour, beams of size 100 x 150 x 1200 mm were cast for 10% RHA and 10% MK for fresh and seawater mix. Ultimate load carrying capacity of ternary blended HSC prepared with fresh and seawater was found to be higher for control concrete.

Keywords: HSC, fresh water, seawater, Rice husk ash, Metakaolin, Strength properties

Paper ID 132

Using Construction Sequence Analysis to Mitigate Risk and Prevent Failure

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Nowadays, limitations on the expansion of horizontal urban infrastructure necessitate the incorporation of various architectural complexities, such as soft storeys or floating columns, at numerous storey levels and positions in tall buildings. The presence of floating columns in the structure causes a discontinuity in the load transfer path, which is fatal during earthquakes. The realistic stage-wise design of tall buildings, which deviates from the conventional approach, is appealing to designers globally for these reasons. This paper employs ETABS v20 to deal with multi-storey reinforced concrete buildings analyses covering a 5-30 storeys range of varying bay widths and storey heights. For the same static loads, a relative assessment of the full-frame models' analyses, followed by a stage-wise examination of each model, yields a conclusive response to the query of how Construction Stage Analysis is used to prevent failures during a building's construction phase and service life. Based on evaluated structural responses, the analysis provides information about the impact of using two specific concrete grades for a group of concrete members to assess the effects on axial shortening.

Keywords: Construction Stage Analysis, ETABS, concrete grade, reinforced concrete, multi-storey buildings, axial shortening.

Paper ID 134

Challenges and opportunities for Sustainable construction Demolition waste management in India: A Review of Policies, Practices and Prospects

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Construction and Demolition waste management in India is a Critical issue due to the massive amount of waste generation and the environmental impact of improper disposal. The study reviews the current state of CWD management in India, including the policies and regulations, the challenges faced and potential solution for sustainable CDW management. The paper proposes the adoption of circular economy principles such as reuse, recycling and redesign of CDW, to reduce the environmental impact and create economic opportunities. Moreover, the study highlights CDW management initiatives in India, such as the use of recycled CDW in road construction, establishment of construction and demolition waste processing facilities and the integration of CDW management. As per the survey the types of waste material having applicable strength and might be used for construction work again most of the researcher suggests the use of recycled material in construction. The paper emphasize the urgency of addressing the CDW management issue in India and the need for collaboration between the government, the private sector, and the community to achieve sustainable CDW management

Keywords: Construction and Demolition waste, 3R Reduce, recycle, Redesign Policy.

Paper ID 146

Mechanical and Durability Properties of Concrete Using Residual Plastic Waste Powder

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Plastic waste is being generated in tremendous proportions all over the world. The disposal of this waste is difficult task since it pollutes the land and water bodies, which causes a great threat to human health and environmental pollution. However, because of its versatility (flexible, strong, lightweight, and inexpensive), the reuse of plastic-waste in construction industry certainly reduces the problems and indirectly preserves the natural construction materials, energy, and protects the environment from possible plastic-waste pollution. Plastic-waste is effectively being used as a partial replacement for fine and coarse aggregates in concrete. In the present study, residual plastic-waste powder (generated from the plastic oil production plant) is used as a partial replacement of coarse and fine aggregates by 5%, 10% and 15%, respectively. The influence of residual plastic-waste powder on the fresh and mechanical (compressive strength, split tensile strength and flexural strength) properties of concrete is investigated. The durability (Water penetration depth) is also checked for the optimum case (mix). It is observed that the compressive, split tensile, and flexural strength gradually decreased with an increase in plastic powder percentages for both coarse and fine aggregates replacement. It must also be noted from the study, that the strength and water penetration test for 5% fine aggregates replacement with plastic powder yields optimum results. This study reveals that the use of plastic waste powder as a replacement of fine aggregate in concrete provides economic benefits and reduces the solid waste problems caused by plastic to a certain extent.

Keywords: Plastic-waste, Residual plastic powder, Water penetration, Mechanical properties

Paper ID 161

Study on Circumferential and Meridional Modes of Free Vibration Response for fixed base and Column Supported Cooling Tower Shell

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Axisymmetric shell structures, generated by rotating plane curve around an axis of rotation to form a circumferentially closed surface are generally used for hyperbolic cooling towers. These structures are thin and due to their curvature, are not only aesthetically pleasing but also has adequate strength. Considerable research on behavior of cooling towers has been carried out since the development of finite element method. In the present paper, free vibration analysis of fixed base and column supported cooling tower shell is carried out using ANSYS software. The study on modes of vibration (First lateral mode, Torsion mode) and behavior of tower shell in circumferential mode (n) 1, 2, 3, 4, 5, and 6 for Meridional Mode (m) 1, 2 and 3 is observed for fixed base and column supported shell for different uniform shell thicknesses. The analysis results revealed that the natural frequency of the First lateral mode is unaffected by change in the shell thicknesses, but it occurs earliest in the thickest shell. Influence of shell thickness on torsion mode was observed to have no significant change except change in mode number. The study of circumferential mode (n= 1, 2, 3, 4, 5, 6) for Meridional mode (m=1, 2, 3) for fixed base shell with different shell thickness (Uniform along the height) revealed that the frequency values alter for circumferential mode ($n \geq 4$) greater than or equal to 4. The study of circumferential mode (n= 1, 2, 3, 4, 5, 6) for the Meridional modes (m=1, 2) for column supported shell with different shell thickness (Uniform along the height) revealed that the frequency values alter for circumferential mode ($n \geq 1$) greater than or equal to 1.

Keywords: Cooling tower shell; lateral mode; torsion mode; frequency; free vibration.

Paper ID 162

Effect of Wind Load on RCC and Steel Buildings in Different Terrain Category

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With increasing population in developing countries, and scarcity of good land for construction high rise building have become a vital alternative. As the height of building increases wind load becomes a vital parameter to be considered for an analysis and design of high-rise structure. In this work G+39 building is analysed for wind loading by varying the wind zones and construction material i.e., RCC and steel in all four terrain categories. In all 48 models of the building are analysed using ETABS v20 and the wind load is applied using IS 875 (Part 3) 2015. The result obtained are plotted in, bending moment, storey drift, displacement.

Keywords: Wind Load, High-rise building, Storey displacement, Storey drift, Shear force, Bending moment.

Paper ID 164

A Study on Repair Effectiveness of Damaged RC Beams with Circular Openings Using CFRP Sheet

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To accommodate essential utility services such as HVAC systems, electric lines for electricity and computer network, plumbing for sanitary lines and water supply etc, transverse openings are provided on the RC beams. These openings become a source of potential weakness. Thus, it is important to understand the behaviour of the beam imposed with openings and the effects on its strength and serviceability. Circular, square or nearly square holes may qualify as small openings if their depth is not more than 40% of the total depth of the beam. As a result, the design and analysis of a beam with small openings may proceed similarly to that of a solid beam. By the inclusion of openings, non-uniformity of the section is caused, that results in interruptions or disturbances in the usual stress flow and also early cracking in the vicinity of the opening. To regulate width of cracks and avoid potential premature failure of the beam, special reinforcement, around the periphery of the opening, should be provided in adequate amount. Retrofitting can be adopted to gain the beam's strength and serviceability. One of the potential materials for fixing damaged infrastructure is Carbon Fibre Reinforced Polymer (CFRP) sheet. 9 beams were cast and 3 beams were considered as control beams, among which 3 beams (BH) were pre-cut beams of circular openings with special reinforcement given around the opening, Remaining beams were posting cut for same diameter and repaired using CFRP at the hole circumference and beam surface. All the beams were tested under two-point loading and the results were drawn in terms of ultimate load, cracking load, shear pattern and load vs deflection parameter. Based on the experimental investigation conducted on Reinforced concrete (RC) beams, control beams, (BM) underwent maximum deflection when subjected to static loading test. Beams designed for openings, BH show least deflection which proves to be the best method for providing an opening in a beam in this study and application of CFRP helped in arresting shear cracks in the beams and enhanced the ductility of the beam.

Keywords: RC Beam with Pre-cut openings, RC Beam with Post-cut openings Carbon Fibre Reinforced Polymer (CFRP) sheet, Strengthening.

Paper ID 177

A Review on Current Materials, Their Failures & Advancements in Railway Sleepers

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The materials and technology used in the production of railway sleepers have advanced from conventional wooden sleepers to composite sleepers. The strength, service life and durability of sleepers are always the major concern when placed on the tracks. Though many measures were being taken, the service life and durability are still the limitations with the sleepers. This paper presents a comprehensive review on types of railway sleepers used, their advantages, limitations and latest technologies adopted during production. It is learnt that the conventional sleepers used suffer from the problems like fungal decays, rail-seat abrasion, high degree of wear and tear which increase their operational and maintenance cost. The alternative materials and technologies used in the manufacture of railway sleepers across the world to improve its durability was reviewed critically. The laboratory and field studies reveal that the use of fibers, mineral admixture, prestressing technologies and composite materials show better prospects in the design life and serviceability. Fly-ash based sleepers have turned to be a cost-effective and environmentally friendly alternative to conventional sleepers. Composite sleepers with glass-fiber polymers used in longitudinal and transverse directions have improved the flexural and shear carrying capacities of the sleepers. Basalt polymers fibers and basalt fibers as pre-stressing material can be viewed as a cost-effective alternative, to improve the durability of concrete sleepers.

Keywords: Durability of sleepers, Sleeper damages, Alternative materials, fiber polymers

Paper ID 194

An Experimental Investigation on The Durability of Rice Husk Ash and Zirconium Oxide Nano-Particles Used in Mortar as Partial Replacement Material

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This paper investigates the influence of using nano zirconia and RHA used as a partial replacement of cement and sand in mortar respectively. In the investigation, the water absorption percentage, ultrasonic pulse velocity, the effect on mortar after heating at various temperatures, SEM, and XRD were recorded. The use of sand in construction is increasing day by day. So, this is necessary to find a better alternative to sand. When RHA is burnt at a controlled temperature of 600oC, the RHA shows similar properties to sand [9]. It can be used as nanoparticles in construction material. The zirconia was added in different percentages (1-5%) in the mortar and RHA was added as a replacement for sand (10-50%). All specimens are in the ratio of 1:3 (cement: sand) The optimum value of both the new materials added was found by checking their compressive strength. Both optimum values were combined in one mortar and then found new mortar that is 3% of zirconia and 50% RHA was added. The results reveal that the water absorption percentage is decreasing when zirconia is added and when RHA is added the water absorption percentage is less but increases gradually as compared to the normal mortar. The compressive strength is high at 3% zirconia mortar i.e 36.26 MPa and 50% CBRHA mortar i.e., 30.76 MPa at 28 days. The ultrasonic pulse velocity test results reveal that after adding zirconia and RHA, it improves the quality of mortar. The highest ultrasonic pulse velocity is recorded at 3% ZrO2 and 50% RHA i.e 4.6 Km/s and 6.28 Km/s respectively at 28 days. The maximum temperature, combined mortar can bear is recorded as 400oC and after heating, the weight loss percentage is 18%.

Keywords: zirconium oxide, CBRHA, UPV, SEM, XRD, water absorption.

Paper ID 195

Characteristics of Fiber Reinforced Polymer Piles through Finite Element Modelling

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Fiber reinforced polymer (FRP) has gained significant attention as a material for pile reinforcement due to its superior mechanical properties such as high strength, durability, and corrosion resistance. In this study, carbon fiber reinforcement polymer (CFRP) and basalt fiber reinforcement polymer (BFRP) are used for FRP piles. The major goal of this study is to assess the mechanical strength of piles with or without FRP. To achieve this goal, numerical model-ling of FRP pile has been performed. To obtain the behavior of FRP materials experimental work has been carried out in this study which includes the compressive strength, tensile strength and flexural strength. The result shows that the flexural strength of conventional beam, CFRP beam and BFRP beam is 4.2 Mpa, 7 Mpa and 6.6 Mpa. Also, validation study has been carried out between experimental work and numerical modelling in which the error difference of flexural strength between experimental work and numerical modelling is found to be 6.3%, 5.1% and 6% respectively. The performance of piles has been evaluated in terms of strengths, failure analysis, stress and strain profile. The significance of this study is to minimize the maintenance cost of piles during its service life and to reduce the risk of damage or failure of piles under marine conditions.

Keywords: Fiber reinforced polymer, Pile, Flexural strength, Finite element

Paper ID 197

Combined Metakaolin and Ground Granulated Blast-furnace Slag induced Concrete for Marine Environment

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Concrete is the most used substance in the construction industry; however, some environments—like Marine regions—and conditions—weather, soil, purpose of structures—have posted major challenges to some concrete structures; therefore, re-searchers have been finding ways to enhance the properties of normal concrete in order to mitigate or reduce these challenges. Incorporating extra materials called ad-mixtures is one of the major ways; however, the type of admixture, the proportion at which they should be incorporated and the properties to be influenced in order to perform better in various environment and conditions are still been investigated. In this light, this study experimented the combined usage of Metakaolin (MK) and Ground Granulated Blast-furnace Slag (GGBS) by partially replacing cement at 40%, 50% and 60% and maintaining water to cementitious content (w/cm) at 0.45. The experimental program included tests on Concrete Durability Properties such as Water Absorption, Permeable Void and Sorptivity as well as Compressive and Flexural Strength of concrete exposed to artificial saline water. This study found out that samples with 40% cement replacement by 30% GGBS and 10% MK performed better than other partial replacement levels in regards to compressive strength and the over-all durability properties investigated.

Keywords: Mineral Admixture, Concrete Durability, Marine Environment

Paper ID 200

Seismic Study on Step Back Buildings and Step Back Set Back Buildings by Providing Bracing in the Soft Storey

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RCC buildings located in hilly areas with irregular configuration needs special attention while carrying out seismic analysis when compared with the RCC structures in level sur-face. Structural irregularities are important factors that reduces seismic performance of buildings. Some vertical irregular structures are step back and step back setback buildings. A study on the seismic behaviour of step back building configuration and step back setback building configurations were carried out. Past experiences revealed that seismic failure usually occurs in buildings having soft story developed at ground level. To reduce the effect of soft story developed in step back building and step back & set back buildings, bracings of different types were provided at ground floor level and analyzed, as bracings function as horizontal load resisting system. Bracings were provided at both internal and external bays. Different types of bracings like chevron, X and diagonal bracings were considered. Response Spectrum Analysis was conducted using ETABS software. This study was aimed to measure structural responses in terms of total story displacement, inter-story drift ratio and torsional irregularity. The results of the analysis were compared with buildings without bracing and the improvement in seismic performance were identified. From the studies it was concluded that chevron bracings performed well under seismic conditions in the case of step back set back buildings.

Keywords: Vertical irregularity, Response spectrum, Story displacement, Story drift, Torsional irregularity

Paper ID 203

Experimental Behaviour of Square High Performance Concrete Slender Columns under Biaxial Eccentric Loading

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In this research, an experimental investigation of the behavior of square high-performance concrete (HPC) slender columns was carried out. A total of Eighty-One Square High Performance Slender (SHPS) Columns subjected to axial, uniaxial and bi-axial loading were constructed and tested. The primary test parameters were the Grade of HPC (varied from M60 to M80), steel ratios (2.01% to 4.52%), and eccentricity along major axis was 38mm. The test outcomes demonstrate that these parameters in-fluence the strength and behavior of Square High Performance Slender Columns. The steel ratio is a significant factor that influences the bearing capacity of column specimens, as it was shown in the experiment, and the load carrying capacity of the specimens increased highly with increasing grade of concrete. Proper material constitutive models for square high performance slender (SHPS) columns are developed and validated against experimental data using the nonlinear finite element Software ANSYS. A comparison of experimental failure loads to predicted failure loads using the method de-scribed in the reference showed good agreement. In the experiments, novelty is observed that as the load increases and deflection decrease with the increased strength of concrete for uniaxially and biaxially loaded columns. It is observed that columns tested in bi-axial loadings are more sensitive than axial and uniaxial columns.

Keywords: Slender Reinforced Column, High Performance Concrete, axial, uniaxial, biaxial loading.

Paper ID 250

Experimental Study on Strength & Durability Characteristics of Mortars with TiO_2 Nanoparticles

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With the advent of Globalization, demand for infrastructural facilities is also increasing day by day. Concrete being the most promising material widely used in the construction industry all over the world because of its high strength, permanence and durability. In view of improving the living quality of environment, scope for protecting the environment is also getting higher. From Civil Engineers prospective, making the building "green" to environment is the most challenging task at present. Further optimization in strength, toughness and durability characteristics becomes primary objective for the researchers. TiO_2 Nanoparticles having higher specific areas improves the microstructure of the concrete which in turn promotes higher strength. Addition of TiO_2 in concrete with photocatalytic and self-cleaning property can enable functionalities that contribute to the reduction of air pollutants leading to the maintenance of aesthetic characteristics such as color and decrease the environmental impact of construction materials. In the present study, an attempt has been made in assessing the strength and durability characteristics of Mortars with different weight ratios of TiO_2.

Keywords: Mortar, Compressive Strength, Durability, Nanoparticles.

Paper ID 286

Assessing Mechanical Properties of Concrete Modified with Use of Nano-silica and GGBS

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Recent technical developments, A lot of attention has been paid to strengthening concrete with nanoparticles. Utilising supplemental cementitious materials (SCM), considerable effort has been made to lower the cement content in construction sector. In this investigation, regular Portland cement will be mixed with supplemental cementitious SCMs, such as GGBS (Ground Granulated Blast Furnace Slag) contain nano-silica. Utilising supplemental cementitious materials (SCM), considerable effort has been made to lower the cement content in the construction sector. The purpose of this study is to use supplemental cementitious materials (SCMs) in combination with regular Portland cement, such as Ground (GGBS) and Nano Silica. The Nano silica is partially replaced with cement at a dosage of 0%, 1%, 2%, 3%, and 4% and GGBS proportions were utilized as 0%, 5%, 10%, 15%, 20% and 25% for cement that is only partially replaced. The water-cement ratio is 0.45 and concrete of the M30 grade was utilized to accomplished the study. The experiments on hardened concrete as compressive test, split tensile strength and flexural strength at 7 and 28-days intervals were conducted. The findings of the study showed that additions of nano-silica and GGBS in concrete can amplify the mechanical properties and durability properties of the concrete. There was a finding that by put in 3% of nano-silica and 15% of GGBS as a cement substitute in some cases resulted in optimum strength of the concrete with regrades of compression, flexural, and split tensile strength test. The UPV findings showed that microstructure improvement of concrete is achieved by adding nano-silica and GGBS which indicate enhancement in durability of concrete.

Keywords: Nano-silica, GGBS, Nanomaterials, Mechanical Properties, Ultra-sonic Pulse Velocity.

Paper ID 316

Simulation of the Flexural Response of RC Beams Reinforced with Polypropylene Fibers (PP) and Utilizing Limestone Calcined Clay Cement (LC3) Using Abaqus Software

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This research investigates the flexural behaviour of Polypropylene (PP) fiber Reinforced Concrete (RC) beams using Limestone Calcined Clay Cement (LC3) as a sustainable alternative to Ordinary Portland Cement (OPC). The flexural performance of RC beams is improved when LC3 cement is used in combination with PP fiber, as evidenced by four-point bending tests of RC beams with different concrete mix proportions. To further explore the flexural behaviour of RC beams with LC3 cement and PP fiber, an analytical simulation was performed using Abaqus software. The model considered the non-linear stress-strain relationship of concrete, the influence of PP fiber, and the heterogeneity of the concrete material. The analytical simulation's results demonstrated the appropriateness of Abaqus software in predicting the flexural behaviour of RC beams with LC3 cement and PP fiber. Additionally, a parametric study was conducted using Abaqus software to examine the impact of various parameters on the flexural behaviour of RC beams with LC3 cement and PP fiber. The findings suggest that increasing fiber content and concrete strength enhance the flexural strength and ductility of RC beams. In conclusion, utilizing LC3 cement and PP fiber in RC structures is a sustainable and cost-effective approach to enhance the flexural performance of RC beams. This research provides valuable insights for engineers and researchers in the construction industry on the use of LC3 cement and PP fiber in RC structures and the Abaqus software's potential in predicting the flexural behaviour of RC beams.

Keywords: Flexural behaviour, Polypropylene fiber, Limestone Calcined Clay Cement (LC3), Abaqus software, Reinforced Concrete (RC) beams

Paper ID 325

Comparative study between alkali activated mortar and conventional mortar towards sulphuric acid

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The alkali activated concrete (AAC) is an eco-friendly alternative to ordinary portland cement (OPC) concrete. AAC reduces carbon emissions by the usage of aluminosilicate materials instead of OPC. The buildings and other concrete structures can be exposed to acids throughout its service life, especially in marine buildings, factories, agricultural, and sewage components. This study aims to the comparison of resistance of AAC and conventional mortar towards sulphuric acid (H2SO4) attack. The materials used for the preparation of AAC mortar specimens are cementitious components and alkaline activators. The cementitious components are GGBS and fly ash as the binding material of ratio 1:9. The alkaline activators used are sodium hydroxide (NaOH) solution of 8M and sodium silicate (Na2SiO3) solution, which has a ratio of 1:2.5. Sulphuric acid of 98% assay is used for preparation of the 5% acid solution. Totally, 9 cubes for AAC and 9 cubes for OPC mortar specimens of size 7 cm x 7 cm x 7 cm were prepared and the specimens were shifted to H2SO4 and the changes have to be observed by visual appearance, mass loss, volume change, pH value and compressive strength test at the age of one month duration. The results suggest that alkali activated mortar specimens show better performance than OPC mortar specimens.

Keywords: Alkali activated concrete, Ground granulated blast furnace slag, Fly ash, Sulphuric acid

Paper ID 331

Experimental and Numerical Study on Hysteretic Behaviour of Laminated Rubber Bearing under Quasi Static Loading and its Performance on Secondary System

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Characterization of the laminated rubber bearing is done experimentally. Linear and non-linear parameters are identified from the numerical meth-od. The hysteretic behaviour of the laminated rubber bearing is determined by cyclic shear and vertical stiffness test. Result shows that the shear test with in-creased axial loads resulted in a marginal reduction up to 7% in shear stiffness of the laminated rubber bearing. The bearing is modelled with equivalent linearization and non-linear methods on secondary structure with the properties obtained from the test. The analysis results show that the response of base isolated secondary structure is significantly affected by hysteretic properties of the bearing. Though actual prediction of the response can be obtained considering the area under the hysteretic loop equivalent linearization can be done for narrowly damped laminated rubber bearings for conservative results. Numerical study carried out on five story moment resisting steel frame. The isolated SDOF secondary system is kept on different floors of the primary system to analyze the different responses. In a result, laminated bearing well intercepted the earth-quake excitations having predominant frequencies less than 2 Hz from its base. For earthquake excitations the response has been reduced up to 51%. But the sinusoidal excitation with frequency 3 Hz was unable to perform satisfactorily and increased the acceleration response instead of decrease. Based on the numerical and experimental study it can be concluded that the laminated rubber bearings are effective for lower frequency excitations.

Keywords: Base Isolation, Laminated Rubber Bearing, Secondary Structure, Linearization

Paper ID 341

Development of methodology of Structural Audit for Water Treatment Plants to improve resilience to natural disaster

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In the event of a natural disaster, supply of adequate quality & quantity of drinking water to the affected population and the relief camps is a very significant post disaster relief activity. To ensure the objective a co-ordinated relief effort and timely preparedness is essential to keep the Water Treatment Plants (WTP) in a functional condition in the post disaster scenario. Periodic structural audit of WTP can ensure that the structural flaws and other non-structural defects, which could affect the functionality of WTP in the post disaster scenario are identified & rectified. In this paper a methodology for structural audit of WTP shall be developed which shall help in identifying the structural flaws in the various units of WTP and the allied infrastructure and shall suggest remedial measures to keep the facility functioning in the post disaster scenario. The methodology shall be a questionnaire-based tool, to enlist all the salient information pertaining to the WTP. The exercise can be taken only by expert surveyors having considerable exposure in the field of Water supply Engineering, and is essentially a technical exercise. The present exercise is focused on the conventional type WTP which most popular in India. Such WTPs are spread on an extensive land area, and are mostly located beside major rivers. Hence, they are more prone towards natural disaster. The expected outcome of the research is to improve post disaster response of the WTP structure to effectively ensure water supply to the affected population.

Keywords: Water Treatment Plants (WTP), structural audit, disaster scenario.

Paper ID 345

Mechanical Properties of Alkali-Activated Geopolymer Concrete

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Environmental pollution is the most important problem in the world and the construction industry responsible for it due to the emission of greenhouse gas to the atmosphere. In particular, cement is the unavoidable binding material in the construction field and the production of cement releases a huge amount of carbon dioxide and it increases the rate of environmental pollution. To reduce this phenomenon, the researchers studied about alkali activated geopolymer concrete (AAGPC) to produce a good alternative to cement concrete and it is also helpful to reduce the dumping of waste products from steel industries and the coal industry. In this study, the workability and mechanical properties of AAGPC and conventional concrete were analysed by conducting slump test, compression test, split tensile strength test and flexural strength test. The experimental results suggest that, AAGC shows better performance in its hardened concrete property compared to conventional concrete; hence it can be used in construction industry

Keywords: Alkali activated geopolymer concrete, Workability, Compressive strength, Flexural strength and Split tensile strength.

Paper ID 347

Steel Twin Lintel Band as Retrofit Technique for Masonry Buildings: Design and Optimisation for Varying Seismic Load

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It is common that earthquakes cause significant casualties and extensive damage to masonry structures. The majority of India's tenements are Unreinforced Masonry structures, which are weak and susceptible to damage even in moderate earthquakes. The collapses of masonry walls have been attributed to a variety of causes, which may be caused by insufficient flexural strength of Unreinforced Masonry or by the lack of integrity of nearby structural components, by reduced shear capacity of poor mortar, by due to poor tensile and shear strengths, and insufficient connections between the load-bearing components. Several approaches have been developed for retrofitting existing masonry buildings in order to preserve their integrity and stability. In this paper Steel Twin Lintel Band method was used as a retrofit technique for Masonry Buildings. Steel twin lintel band was designed and optimisation was carried out. Depth of steel lintel band was optimized for various seismic zones. Performance of Retrofitted Steel Linted masonry structure was compared with Unreinforced Masonry for various zones. Various parameters were checked for Unreinforced Masonry and Retrofitted Masonry such as Stresses, Displacements, Drifts, Base Shear etc. Steel Lintel Band was found to be more effective and followed permissible codal provisions. The effectivity of this retrofitting method was studied in this paper. It is hopeful that this paper will provide comprehensive information on using twin steel lintel band as one of the retrofitting methods.

Keywords: Steel Twin Lintel Band, retrofitting technique, masonry buildings, seismic evaluation, etc.

Paper ID 359

Determining the Mechanical and Structural Performance of Conventional Concrete with Recycled Concrete Aggregate-Based Self-Curing Concrete

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In the actual world, conventional curing techniques usually fall short. Water evaporation is typically reduced even when precise management methods are employed, but excess water on vertical structural elements is still a problem. To achieve the necessary attributes in conventional concrete buildings, the procedure of strength-gaining is essential. To acquire the necessary strength, concrete must cure for 28 days with the proper amount of water. Poor curing can reduce a material's strength and longevity. Self-curing is a modern technique for curing concrete that, because to the moisture content, fixed itself. When polyethylene glycol is utilized in conventional with recycled concrete, the ingredient helps to maintain optimum hydration. It helps in the manufacturing of water-soluble emulsification, detergents, plasticizing agents, and textiles lubrication. In the current experiment, polyethylene glycol-400 addition in recycled concrete would result in strength. Considering how short water resources are right now, the building industry requires a different approach to deal with the water issue. The adoption of alternative materials quickly lowers the cost of construction. For concrete to self-cure, it was proposed that polyethylene glycol PEG400 chemical be added. In this study, the relationship between PEG400 in addition to cement—which varies from 0% to 1.5% by weight—and self-curing concrete is examined. Both conventional and self-cured concrete were tested and contrasted based on the findings of the M25 grade mix test results for split tensile, flexural, and com-pressive strength. Results further show that self-cured PEG-cured specimens are more acid resistant than conventionally cured specimens.

Keywords: PEG400, M25 grade, Self-curing, Conventional curing, Recycled concrete.

Paper ID 364

Experimental and Analytical Study of Building Models (Frames) Subjected to Free vibration Response using Horizontal Shake Table

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Shear wall and bracing systems are one of the most commonly used lateral load resisting systems in high rise buildings. Shear walls and Bracings systems have very high in-plane stiffness and strength, which can be used simultaneously to resist large horizontal loads and support gravity loads, making them quite advantageous in many structural engineering applications. The present paper focuses on study of building models (frames), bare frame model and model including shear wall and X and V type bracings system subjected to free vibration response using horizontal shake table experimentally (using shake table test), analytically (using ETABS software) and theoretical solution. The scale down building models SDOF and MDOF (G+2 and G+3) systems are subjected to free vibration to required amplitude to study the vibrational characteristics in terms of natural frequency and mode shapes. It is observed that the natural frequency values obtained for model including shear wall and bracing systems are higher than that of bare frame models. Hence the presence of shear wall and bracing systems adds 20% to 35% stiffness to the building frames. Further it is observed that X bracing system is effective in resisting lateral forces as compared to other types of bracing systems.

Keywords: Bracing systems, Shear wall, free vibration, horizontal shake table

Paper ID 367

Epoxy Resin Treated Bamboo Reinforced Concrete Beams for Rural Construction Buildings

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The bamboo used in construction is widely known and well-established in rural areas. Also, using bamboo as a concrete reinforcement member can be minimized CO_2 emissions of steel reinforced concrete members. This study used bamboo that had already been pre-treated with epoxy resin and subjected to sandblasting to increase friction between the bamboo and cement mortar. In addition, tests were performed on the flexural and durability of the bamboo-reinforced concrete beams. Compared to steel-concrete beams, the failure mechanism of reinforced concrete beams is not considerably altered when bamboo reinforcement is used instead of steel reinforcement in concrete. However, the initial crack load showed better results. The transverse loading tests are carried out for plain, steel, and bamboo reinforced beams to assess the ultimate load, deflection, and failure mode pattern. Moreover, durability tests are performed on beams to examine how they respond to various exposure conditions. These experiments indicate that bamboo may replace steel as a beam-reinforcing material with proper pre-treatment for low-cost construction buildings.

Keywords: bamboo, sustainable material, low-cost construction, flexural strength.

Paper ID 369

SAP2000 Software Analysis and Design of the Intze Water Tank

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The focus of the current study is on the manual approach and SAP2000 software for gravity and lateral loading in the analysis and design of raised water tank constructions. For the study, a standard Intze water tank is taken into account. SAP2000 software is used to model the structure using a combination of plate and line elements. Vertical and horizontal water pressure as well as the structure's own weight make up the gravity loading. According to the guidelines in IS 1893, the lateral loading takes the form of seismic loading. Combinations incorporating gravity and lateral loading are examined for the structure. Additionally, pushover analysis is done. The structure is then created utilising manual and SAP2000 procedures for the internal forces. SAP2000 is a practical and effective tool for the analysis and design of water tank constructions, according to the findings of the current study. The push over curve demonstrates the structure's ductility. Both the manual approaches and the design output from SAP2000 are in strong accord.

KeyWords*:* Wind Load, Seismic Load, Intze Tank, and I.S.Codes, SAP2000

Paper ID 409

Structural Performance of a Perforated Hybrid Stainless Steel I-Beam

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Stainless steel grades are emerging in industries due to their properties like resistance to corrosion, durability, weldability, minimal maintenance requirements, good aesthetic appearance, and ductility. Also, stainless steel can be recycled and is good fire resistant. Hybrid sections with a higher-grade flange and lower-grade web are used in construction to improve the stability of an I beam. it is important to investigate the structural behavior of a hybrid stainless steel section containing perforations in its web because perforations are essential for the passage of building services like ducts for water, air conditioning, electricity, etc. A numerical investigation on the flexural behavior of perforated Hybrid Stainless Steel (HSS) I-beams using the commercial finite element software, ABAQUS is presented in this paper based on cross-section slenderness i.e., flange and web critical sections. 3-point bending (3PB) specimens were chosen for the current numerical investigations. The stainless-steel varieties lean duplex stainless steel and duplex stainless steel are taken as the materials for the hybrid steel section.

Keywords: First Stainless steel, Lean duplex stainless steel, Duplex stainless steel, Hybrid stainless steel, I-beams, 3-point bending.

Paper ID 423

The Influence of the Non-Dimensional Slenderness Ratio on the Flexural Strength of Beams

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This paper deals with the effect of the non-dimensional slenderness ratio (λlt) on a member's ability to flexural behavior, which was studied numerically using a wide range of built-up I-sections. There are two types of flexural member failure: yielding and lateral torsional buckling. Instead of section classification, the non-dimensional slenderness ratio (λlt) determines the type of failure. The design procedure for flexural design strength of member, When the λlt value was less than or equal to 0.4 The yield stress governs the flexural design strength (laterally restrained member), It denotes that the component can form plastic hinges and has the necessary rotational strength for the structure to fail due to the development of plastic mechanism. When the λlt value was greater than 0.4 then the flexural torsional buckling strength governs the design bending strength (laterally un-restrained member), which means the member can't develop plastic hinges and the member failed before the formation of plastic mechanism. As a part of the research, we are focusing on how the non-dimensional slenderness ratio affects the flexural capacity of a member by conducting a parametric study on built-up I-sections. It was observed that even though the section was under the plastic section and compact section, the member failed before reaching its yield stress when the λlt value was higher than the limiting proportional value. The design bending moment capacity was determined based on the non-dimensional slenderness ratio (λlt) rather than the cross-section classification.

Keywords: Non-Dimensional slenderness ratio, flexural member, Flexural-torsional buckling, Design bending moment.

Paper ID 447

Optimization Studies on Bracing Systems and its Effective Placement to Counteract Earthquakes in Very High Damage Risk Zone

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India has a devastating history of earthquakes. The important reasons for high frequency and intensity of the earthquakes is that the Indian plate is driving into Asia approximately at a rate of 47 mm/year. The recent version of seismic zoning map of India as given in the earthquake resistant design code of India [IS 1893 (Part 1): 2016] assigns four zone factors depending on the level of seismicity. Zone V is more prone to earthquakes and is also called Very high damage risk zone. The current study deals with analysis of a multi-storey RC building model subjected to lateral loads induced by Zone V earthquake. In this method, a G+14 storey building is modelled using ETABS v.20 and the model is acted upon by a peak acceleration of an earthquake and analysis is done by Response Spectrum Method. The building models considered incorporate lateral stiffness systems such as X-Bracings, Inverted V-Bracings (concentric) and K-Bracings (eccentric) placed at various locations in the building models to resist lateral loads. The positions, type of bracings and their efficiency in resisting the earth-quake loads is studied based on seismic parameters such as storey displacement, storey shear, overturning moment, storey stiffness, and time period. The most effective lateral system and its position, based on performance is observed. From the studies, it is found that the optimal way to place the bracings is at the centre like a braced core system. The second-best position is placing them at the middle periphery of the building. Eccentric bracings perform the best com-pared to any other type of bracings.

Keywords: Bracings, Concentric and Eccentric bracings, Elastic Stiffness, Lateral Load Resisting Systems, Response spectrum, Storey displacement, Time period.

Paper ID 478

Seismic Evaluation of Retrofitting Techniques for Masonry Buildings and their Comparison with Confined Masonry

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Unreinforced Masonry is one of the most common building construction typologies around the world, which are known for its cost-effectiveness. However, they are weak in resisting lateral loads and are vulnerable and prone to cracks, collapse due to strong external factors that includes earthquake, strong winds, blast, etc and also due to structural distress majorly because of aging. There are methods to retrofit unreinforced masonry buildings to increase the overall strength and to increase the time that is required for collapse vary at large. However, most retrofit techniques are costly and require expertise to implement. In this paper, retrofit methods were reviewed and compared with confined masonry. The first retrofitting measures included strengthening walls by shotcrete (62.5 mm M25 layer over walls) and the second measure involved strengthening of walls by providing a 20 mm WMM layer (M1 mortar layer with 75 mm X 75 mm X 4 mm wire meshing). Shotcrete retrofitted masonry, WMM retrofitted masonry and confined masonry structures were modeled, and equivalent static analysis was carried out. Various stresses (compressive, tensile, and shear) and seismic parameters (drift, displacements, base shear, modal analysis) were analyzed and compared. The confined masonry structure showed improved structural and seismic behavior which complied with the codal limits. It is expected that this paper will provide useful insight and information about the seismic performance of retrofitted masonry structure and confined masonry structures.

Keywords: Equivalent Static Analysis, Shotcrete-Retrofitted Masonry, WMM masonry, Confined Masonry.

Paper ID 491

Performance Studies on Structural Floor Systems – An Analytical Approach

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The floor slab system is a major and most important part of the structure in a building. Basically, slabs are designed to take care of the gravity loads whether it may form the floor of a basement, ground level or at upper levels. The slab thickness will play a vital role in building aesthetics, architectural aspects, de-sign, cost, and construction. The increased slab thickness will lead to increased self-weight, material quantity, and thus affect the economy. The present study attempts to evaluate the performance of different floor slab systems namely conventional slab-beam system, RC flat slab, RC band beam and bonded post-tensioning slab system for commercial building under gravity loads. The building consists of ground floor + 10 stories + roof terrace. The floor area for each floor (typical) of the building is about 1600 sqm. The analysis & design for the floor slab systems were carried out by using software and the results are also verified by manual calculations as per standards. The results show that PT slab carries more strength capacity than other slab system and it shows better performance under serviceability and strength conditions. However, PT slab requires slender section with less material consumption along with more structural performance than other slab systems for commercial building.

Keywords: ADAPT- Builder, Band Beam, Floor System, Flat Slabs, PT Slab.

Paper ID 497

Study on Compression Strength of Masonry Prism Using Cementitious Grouting Material as Mortar

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Masonry constitutes masonry units and mortar. Masonry carries pre-dominantly compressive forces and the compression strength of a prism mainly depends on the strength of the masonry units and it is less sensitive to the strength of the mortar. Literature reveals that the compression strength increases with an increase in bond strength. So an attempt is made to study the effect of an increase in the strength of mortar and bond strength by using commercially available cementitious grouting material as mortar in order to achieve the requirement. Five brick height masonry prisms corresponding to the h/t ratio of 3.95 is being used to ascertain the compressive strength at 3, 7, and 28 days. The mortar joint thickness was limited to 5mm with grouting material as mortar, the intention of faster construction. The compression test results are compared with the conventional mortar of 1:3. The results such as compressive load and strain were ascertained in the saturated condition. Masonry prism with conventional mortar showed more brittle failure than grouting material as mortar.

Keywords: Cementitious grout, Cement concrete brick, Compressive strength.

Paper ID 505

Studies on Flexural and Shear Bond Strength of Masonry Using Cementitious Grouting Materials as Mortar

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This paper presents an experimental investigation of the flexural and shear bond strength of the masonry prism. The masonry prisms were constructed in triplet prisms for the shear bond strength test and five levels of stack-bonded prisms for the flexural bond strength test. The bond characteristics of masonry depend on the mortar type and the surface texture of the masonry unit used. To increase the flexural and shear bond strength present work is carried out by using cement concrete bricks as masonry units and grouting materials as thin layered mortar. Most of the work is done on the conventional mortar of 10 – 12 mm thick however 1- 5mm thick masonry bond is not yet well researched, hence 5mm thick mortar joint is used for both flexural and shear bond strength for 3, 7 and 28 days and is compared with conventional cement mortar of 1:3 ratio of 10mm thickness. Reduction in the thickness of mortar joints helps in a faster rate of construction. The results reveal higher bond strength for cementitious grouting material as mortar.

Keywords: Flexural bond strength, Shear bond strength, Cementitious grout.

Paper ID 509

Microstructural Study of Concrete Containing Jute Fibre, Sugarcane Bagasse Ash and Nano Alumina

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The research paper investigates the impact of incorporating Nano-alumina (NA), bagasse ash (BA), and jute fibre on the microstructure of conventional concrete. Four different samples were studied: sample 1 (M30) represents conventional concrete, sample 2 involved a 10% replacement of binder with bagasse ash, sample 3 included a 10% bagasse ash and 0.25% jute fibre, and sample 4 contained a 10% replacement of 10% bagasse ash, 0.25% jute fibre, and 1.75% Nano-alumina by volume of mortar. The composition and peak analysis of these samples were conducted using X-ray diffraction (XRD). The results revealed the formation of new peaks in the samples that incorporated Nano Al2O3 (Nano-alumina). This suggests that the inclusion of Nano-alumina(Al2O3) altered the concrete's structure. The study found that the incorporation of Nano-alumina, bagasse ash, and jute fibre resulted in improved strength properties of the concrete. The interfacial area of transition (ITZ) between the mortar mix and aggregates was altered, which was credited with this improvement. Furthermore, the paper highlights that the use of Nanoparticles such as Nano-alumina and additional cementitious materials like bagasse ash and jute fibre can contribute to achieving sustainable development in the building sector. By incorporating these materials, it is possible to reduce the environmental impact associated with cement manufacturing and usage. This suggests that using these alternative materials can help mitigate pollution and promote more sustainable practices in the construction industry. Overall, the research shows that the inclusion of Nano-alumina, bagasse ash, and jute fibre in concrete can lead to positive changes in the microstructure and improved strength properties. Additionally, these alternative materials align with the goal of sustainable development in the building sector by reducing the environmental impact associated with cement production.

Keywords: Sugarcane bagasse ash (SCBA); Nano Alumina (NA); Compressive strength (CS); X ray diffraction (XRD); Flexural strength (FS); Jute Fibre (JF); Split Tensile strength (STS).

Paper ID 516

Assessment of Periphery Free-Standing Masonry Wall for Structural Safety and Integrity

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All around the world, free-standing stone walls are extremely common. They are widely used as private land, household gardens, and industrial and commercial premises barriers. Free-standing walls are built between pilasters, which are rectangular projectile columns made of masonry blocks that offer extra support to the filling wall and base. The pilaster is built at predetermined intervals throughout the wall's length and cantilevered up from the foundation. Masonry units that stretch horizontally between pilasters are known as fillers. Every filler wall between the pilasters is measured and surveyed to determine its deflection and height from the foundation. More deflection is observed along the length of the free-standing wall in the mid-region between the pilasters, and we may compare the deflection by imagining the free-standing masonry wall with the pilaster using survey data. According to the findings of this study, the brick wall is deflected due to vegetation growth and foundation sinking, and weathering action leads the wall to expand and compress, creating fractures.

Keywords: Freestanding wall, Pilaster, Stability.

Paper ID 520

Analysis and Design of Steel Skywalk Bridge

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Bridge, a Civil Engineering structure, used since ancient times for crossing any obstruction beneath it. From the past decades bridges are con-structed using different kinds of materials starting from wood to structural steel which is now has become a large field of study at this period of time. Among different types of skywalk bridges fall under the special category, since it has to specially designed both in architectural and structural point of view and commonly used in hill stations and rocky areas as an attraction for visitors. Skywalks have the best features of a cantilever and allow to view both the sides. In this present work, an innovative steel skywalk bridge is planned to construct by choosing a suitable view point on Chamundi Hills, Mysuru based on the topography, slope and its stability. Preliminary reconnaissance survey has been carried out. The objective of the present work is to find the framing system to support the cantilever skywalk at one location and also to find the optimum span and dimension of structural members. Skywalk for various cantilever projection is modelled in ETABS, and checked for criticality such as increase in deflection and moments overall stability. For the three cases, key results such as cantilever deflection, bending moments in beams and axial forces in critical columns and bracings and finally, sway due to earthquake are presented. The case – 3 is found to be efficient framing system, since cantilever moment is reduced to 82 kN-m, and also side sway.

Keywords: Skywalk bridge, Steel bridge, cantilever steel bridge, ETABS.

Paper ID 522

Performance Evaluation of Fire Exposed RC Structure using Pushover Analysis

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Pushover analysis is a Non-linear static analysis to evaluate the performance of RC Structure under future seismic effects. In Pushover analysis structure is subjected to in-creasing seismic lateral loads until the peak response of a structure is obtained. It provides 'capacity curve' it is a plot of total base shear vs roof displacement. The analysis is carried out up to its failure point which helps in determine capacity and demand of a Fire exposed RC structure subjected to loads. Nowadays raise the problem about the ability of RC Framed structure to resist strong seismic forces, gravity forces and fire effect. The structure are subjected to both seismic loads and fire effect. To achieve objectives here the pushover analysis is carried out to G+9 commercial RC building using Etabs software. The total Plan area of RC building is 576m2.Totally 4 bays along both x and y direction and each bay of length 6m. RC building frame is designed as per Indian standard i.e. IS-456:2000, IS-875:2015 and IS-1893:2016. Firstly the structure is analyzed by linear static under Gravity loads, seismic lateral loads until all the structural members' passes to withstand loads safely. Next under 500o isotherm all the RC Frame members are subjected to standard temperature to obtain the reduced cross section using Microsoft excel. Again to these Fires exposed reduced cross section member reanalysed to linear static as well as pushover analysis is performed to check the performance evaluation of Fire exposed RC structure.

Keywords: Pushover analysis, Non-linear static analysis, RC structure, Etabs, Fire, 500o Isotherm, gravity, seismic.

Paper ID 525

An Experimental Study on the Structural Performance of Full-Scale RC Beams Strengthened for Shear Using NSM GFRP Strips

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More than ever before, there is a growing need for extending the ser-vice life of existing structures by means of retrofitting or rehabilitating given the rising scarcity and increasing costs of raw materials for reconstruction on one hand and on the other, to reduce the emission of greenhouse gases involved in the production of raw material used for construction. Strengthening of existing structures is one way through which the above predicaments can be ad-dressed. In this experimental study full scale RC beam models of size (150 x 175 x 3000)mm of M20 grade concrete were considered to be strengthened for shear with near surface mounted (NSM) GFRP strips and understand the performance of the beam element. GFRP strips were embedded using epoxy in the grooves cut on the side faces of the beam oriented at 45° angle with respect to the beam axis and tested for single point loading. Load – deflection relationship of beam, ultimate load carrying capacity, cracking pattern and mode of failure were the findings of this experimental study.

Keywords: NSM, Shear strengthening, GFRP Strips.

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Paper ID 529

Non-Linear 3-D Finite Element Analysis of RC Beam with and without Externally Bonded CFRP System for Flexural Strengthening

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Use of numerical methods of structural analysis has been common in recent years. This is mainly because conducting laboratory experiments are very costly and time-consuming. Finite element (FE) analysis method, a numerical-based technique, has been used in many commercial packages available to universities and industry to analyze structural behavior of various types of structural elements and components. In this study, ANSYS, a commercial FE-based software package is used to analyze/simulate the non-linear flexural behavior of tested reinforced concrete beams with and without carbon fiber reinforced polymers (CFRP). Results show a close agreement between the experimental results, 3-D non-linear FE modeling results, and calculated values using ACI 318-14 equations for the beams and emphasize the need for further research in simulating the bond behavior between concrete and CFRP sheets.

Keywords: Carbon fiber reinforced polymer (CFRP), Finite element (FE)

Paper ID 532

Experimental Analysis on The Microstructure Study and Mechanical Properties of Concrete on Addition of Nano-Particles TiO2

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Self-cleaning concrete, with its ability to remove pollutants and maintain a clean appearance, has gained significant attention in the construction industry. One promising approach to achieving self-cleaning properties is through the incorporation of titanium dioxide (TiO_2) nanoparticles into the concrete matrix. This article presents a comprehensive analysis of self-cleaning concrete using X-ray diffraction (XRD) and scanning electron microscopy (SEM) techniques. Self-cleaning concrete, known for its ability to remove pollutants and maintain a clean surface, has gained significant attention in the construction industry. XRD analysis provides insights into the crystallographic properties of the material, revealing the composition and structure of self-cleaning concrete. The obtained XRD data shows distinct peaks representing crystalline phases present in the concrete, with peak positions and intensities providing information on phase distribution. SEM analysis complements the XRD findings by offering de-tailed images of the concrete's surface morphology. The microscopic observations reveal the presence of nanostructured hydrophobic coatings on the concrete's surface, contributing to its self-cleaning properties. The combination of XRD and SEM analysis provides a comprehensive understanding of the crystal-line composition and surface characteristics of self-cleaning concrete. The results highlight the effectiveness of XRD in identifying crystalline phases and SEM in visualizing the surface features. This knowledge is crucial for optimizing the formulation and performance of self-cleaning concrete materials in practical applications. Overall, this study emphasizes the significance of employing multiple analytical techniques to comprehensively investigate the properties of self-cleaning concrete and pave the way for the development of advanced construction materials with enhanced self-cleaning capabilities.

Keywords: self-cleaning concrete, TiO_2 nanoparticles, microstructure study, X-ray diffraction, scanning electron microscopy.

Paper ID 559

A Comprehensive Evaluation of Progressive Collapse Analysis: Insights on Research and Regulations through a Systematic Review

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This study summarizes the concern of progressive collapse in buildings, which refers to the failure of a building's structural components when a critical element is lost. The paper highlights a historical overview of this phenomenon and examines the causes and current state of research in the field. This review also discusses various design strategies for preventing progressive collapse, including redundancy, alternate load paths, and ductility, and emphasizes the crucial role of regulations in ensuring building safety. This study suggests areas for further research and recommendations for improving regulations to address the issue of progressive collapse and promote building safety.
Keywords: Progressive Collapse Analysis; Building Safety; Alternate load path; Critical Element.

Paper ID 560

Experimental Investigation on the Strength of Stabilized Geopolymer Mud Blocks with various types of Mortar

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Stabilized Geopolymer mud blocks (SGMB) are high strength and high-density blocks made by compacting a mixture of mud, fly-ash with an alkaline solution of sodium silicate and sodium hydroxide in a block making machine. These blocks can be used for the construction of load-bearing masonry. Mortar, bonds two masonry units together so they function as a single unit in the structure. This paper presents the strength of SGMB masonry using various types of mortar like cement-soil mortar, cement-sand-soil mortar, fly-ash based geopolymer mortar. Some of the conclusions are: 1. The average compressive strength of cement mortar was found to be 6.65 MPa for 1:6 mix and 10.54 MPa for 1:4 mix. 2. The average compressive strength of cement soil mortar was found to be 5.80 MPa for 1:1:6 mix and 6.47 MPa for 1:2:5 mix. 3. The average compressive strength of fly ash based geopolymer mortar was found to be 8.66 MPa for solution to fly ash ratio 0.3 and 10.32 MPa for solution to fly ash ratio 0.5 mix with sodium silicates to 12M sodium hydroxide ratio 1.5. 4. The pattern of failure was found to be spalling at the bottom most block of the masonry prism and vertical cracks propagating from top to bottom of the masonry prism.
Keywords: geopolymer, fly ash, mud blocks, mortar, compressive strength.

Paper ID 569

Time Period Determination for Shaft Type Elevated Water Tank

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An elevated water tank is constructed to store water at a certain height in order to pressurize the water distribution system. Elevated water tanks are often built with framed or shaft-type staging. When the staging height exceeds 15 meters, shaft type stagings are often used due to the fact that they may be constructed with slip form shuttering. In either case, lateral load analysis dominates the evaluation of seismic vulnerability. According to researchers, the elevated tanks supporting system (Staging) is an especially vital structural aspect of the tanks. This paper deals with the stiffness of shaft type elevated tank stagings. This study focus on the stiffness determination from analytical formula to software model implementation. In this work, a shaft type raised water tank staging with varied time periods was taken to examine the difference in tank staging stiffness. It is observed that the conventional method which assumes Staging stiffness calculation is very inaccurate.

Keywords: Shaft type staging, Stiffness, Time period.

Paper ID 572

Soil Structure Interaction Analysis of a Single Layer Reticulated Geodesic Dome Using Response Spectrum Method and Correlation with Artificial Neural Network Model

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In the present study design of the steel truss of the existing geodesic dome is carried out by using the codebook IS 800:2007 code of practice for general construction in steel. The dynamic analysis is also carried out by using IS 1893(Part 1):2016 and Criteria for earthquake resistant design of structures and response spectrum method (RSM) is analyzed as per IS 1893(Part 1):2016 code. The MAT foundation is designed for geodesic dome models for 30 m diameter geodesic dome. To incorporate the soil structure interaction (SSI), the standard soil mechanical properties are obtained by soil test at SSIT campus Tumakuru. The Artificial Neural Network (ANN) model is also developed by using MATLAB 2021Ra.119 and soil spring values are calculated by varying the Standard penetration number (SPT), shear wave velocity, density, and Poisson's ratio for different soil conditions. ANN model is developed with four inputs as Soil spring values and four outputs as Base shear values for zone II, III, IV, and V using the Levenberg Marquardt algorithm. It is observed from the study that the ANN model can predict the dynamic characteristics and seismic response of the soil-structure system with 98% accuracy compared to that of the results obtained by using finite element analysis (FEA).

Keywords: Geodesic dome, RSM, MAT, SSI, ANN, MATLAB, FEA

Paper ID 580

Finite Element Analysis of Steel Fibre Reinforced Concrete Beam Column Joint

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The structural behavior of reinforced concrete moment resisting framed structure subjected to lateral loads is greatly influenced by the behavior of beam column joint. The energy dissipation capacity of the moment resisting reinforced concrete framed structure is based on the inelastic deformation capacity of beam column joint. During lateral loading, there are chances of brittle shear failure in beam column joints. The reinforcement concentration can be reduced and ductility behavior and energy dissipation capacity enhanced in beam column joint by the introduction of fibres in concrete. In this study steel fibre reinforced beam column joint is modelled and analyzed under static loads. Effect of steel fibres on the load carrying capacity, energy absorption capacity and shear strength of beam column joint is investigated based on nonlinear analysis using commercially available finite element software ANSYS. Stress strain behavior of hooked end steel fibre reinforced concrete with fibre content of 0%, 0.5%, 1%, 1.5% & 2% fibres of diameter 0.75 mm and length 50 mm was determined experimentally and these data sets were used as input in the finite element model. Mechanical strength of hooked end steel fibre reinforced concrete was investigated and concrete with 1.5% fibres gave the best results. The load deflection, shear capacity, energy dissipation capacity, and cracking patterns of fibre reinforced beam-column joint is evaluated and compared with reinforced concrete beam column joint.

Keywords: beam column joint, nonlinear analysis, finite element modelling.

Paper ID 581

Modified Steel Tubes of Wind Turbine Tower Subjected to Compression-Bending Load

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The wind turbine towers are essentially a multibody entity composed of rotor-nacelle assembly supported by a tubular tower that transfers the gravity load as well as the environmental load to the foundation. Several thin-walled steel tubes with flanges connected from tubular steel towers. The records show that most of the failure occurred at the bottom of the tube, and the major failure mode was local buckling. Thus, susceptibility to local buckling under compression and bending load accounts for the need for improved structural modification to the tubes of the wind turbine. The static analysis of innovative combined stiffened tubes was conducted by applying a constant axial force and varying lateral displacement. Different shapes of stiffeners, lengths of stiffeners, tube with cut out, etc., were considered and the moment drift angle curve was generated. It was found that among all the considered specimens innovative modified steel tubes could greatly reduce the buckling deformation and increased both ultimate and failure loads. The static analysis of innovative combined stiffened tubes signifies a remarkable improvement in the ultimate moment of 42.85% was recorded and it was also found to be effective in controlling local buckling. The present study did not consider the connection between individual tubular units and residual stresses, apart from that modified steel tube was proven to be a feasible and efficient solution to control local buckling.

Keywords: Stiffened Steel Tube, Drift Angle, Compression Bending.

Paper ID 590

Experimental Investigation on Cold Mix for Road Construction Using Granite Aggregates and Rubber Waste

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Hot mix technology is used predominantly as a paving mix from many decades in road construction. However, certain limitations associated with the hot mix technology are emission of greenhouse gases, high energy consumption, and compromise with the durability of bitumen due to aging during heating, etc. To overcome these disadvantages of hot mix technology, a cold mix technology is proposed by the various researchers to protect the environment as well as for the conservation of energy. In this paper, a cold mix technology is adopted for the preparation of road construction material using granite aggregate. The experimental results are obtained for pure granite aggregates, basalt aggregates and combination of both granite and basalt aggregates. Emulsion content determination test and Marshall Stability test were carried out. Based on the experimental results, it is concluded that the use of granite aggregates gives improved results over basalt aggregates.

Keywords: Cold mix technology, granite aggregates, Emulsion content, Mar-shall Stability.

Paper ID 598

A Feasibility Study on Utilization of Construction and Demolition Waste Material in Low Volume Road Construction

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Due to the rapid growth of infrastructure, natural resources like aggregate became scarce also due to urbanization the generation and extraction of materials like soil, aggregate, cement will have an ecological impact. Therefore, to minimize the environmental impact, waste disposal and global warming, use of C and D waste in concrete is a behaves as a good solution.

Hence, in the present research work the feasibility study of using the construction and demolition wastes in the low volume road construction in rural areas, is presented. The coarse aggregates in concrete are replaced by the recycled aggregate (0 %, 50% , and 100 %) obtained from construction and demolition waste. The main objective of present work is to determine the strength of concrete using RCA. The numerical results of 7 days and 28 days compressive strength of concrete using RCA is presented in the paper. Based on the results the feasibility and suitability study of concrete with RCA is discussed.

Keywords: C and D waste, compressive strength, concrete, RCA.

Paper ID 602

Experimental and Numerical Study on Flexural Behaviour of Deep Beam with Circular Openings Under Static Loading

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The study investigates experimental and analytical behaviour of fiber reinforced concrete deep beams with and without circular opening for ultimate load and crack patterns. Generally deep beams are having overall depth and effective depth(L/H) greater than 2 or 2.5 for simply supported beams and continuous beams respectively. Deep beams are used in a variety of construction structures, including wall footings, transfer girders, basement pile caps and shear walls. The utilisation of a deep beam at the lower level of tall structures for both residential and commercial purposes, in particular has expanded fast. In this study twelve deep beams are casted with different combination of materials like without flyash, with flyash, with flyash & fibre and with Circular opening of diameter 60mm. Casted Beams were tested under two-point load system for ultimate loads. Results of experimental test determine that providing of opening leads to an increase in failure load. The crack patterns of the beam were observed and results are compared with analytical results obtained in ANSYS 2022 R2 software.

Keywords: Deep beam, Circular Opening, ANSYS 2022 R2, Fly ash, Fibre, Shear.

Paper ID 623

Stainless Steel Reinforced Concrete (SSRC): A Review

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Corrosion of steel reinforcement in RC structures is a discernible problem that diminishes the lifetime of a structure, that's why it is known as 'Concrete Cancer'. Due to corrosion the structure is subjected to multiple cracks and spalling of concrete which further leads to the failure of the structure. The repair and maintenance of RC structures cost more and the consequent vibrations may affect the sustainability of the remaining structure. The remedial methods to minimize the effect of corrosion such as increasing the cover, and using anti-corrosive coatings will increase the section sizes, and construction costs and reduces the bond strength. Because of all these aspects stainless steel is introduced as reinforcement which has more corrosion resistance, a long life cycle, and low maintenance requirement. Also, it offers more ductility and strain-hardening properties as compared to conventional steel. By using this stainless steel the initial cost of construction may be high but the maintenance cost will be very less than mild steel. The lifetime of Stainless steel reinforced concrete structures is two times more than regular RC structures. As 'Sustainable infrastructure' is the present trend more research work is going on this stainless steel reinforced concrete. This paper represents a brief review of SSRC containing both material and structural properties, a thorough review of known information, and identifies the research gaps

Keywords: Corrosion, Reinforced concrete structures (RC structures), Stainless steel, life cycle cost analysis (LCCA), Stainless steel reinforced concrete (SSRC), CS RC (Carbon steel reinforced concrete).

Paper ID 629

Mechanical and Durability Properties of Concrete using Hemp Shives as a Partial Replacement of Coarse Aggregates

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The use of traditional coarse aggregate in concrete production has been associated with several environmental issues such as carbon emissions, depletion of natural resources, and waste disposal problems. This has led to an increased interest in developing sustainable alternatives to traditional coarse aggregate. Hemp shives, a by-product of hemp plants, have been proposed as a potential replacement for coarse aggregate in concrete. This study aims to investigate the mechanical and durability properties of concrete produced with hemp shives as coarse aggregate. In this paper, the experimental investigation is done in hemp concrete of M25 grade , Hemp Shives is used as partial replacement of coarse aggregates by 5%, 10% and 15% respectively. The influence of Hemp Shives on mechanical (compressive strength, split tensile strength and flexural strength) properties of concrete was studied and the durability (Water penetration depth, Sorptivity) was checked. Hemp Shives mineralised with aluminium sulphate and calcium hydroxide before using as a coarse aggregate in concrete. The Aluminium sulphate :Calcium hydroxide ratio as 1:2 and cement is replaced by 10% using Fly Ash. The Compressive Strength specimen were investigated at 7 and 28 days while Split tensile, flexural strength, water penetration, Sorptivity were investigated at 28 days. It is found that the compressive, split tensile and flexural strength was gradually decreased with increasing of Hemp Shives percentages by coarse aggregates replacement. However, strength and durability test for 5% replacement of coarse aggregate with Hemp Shives gives a comparable result. The use of hemp shives in concrete production can significantly reduce the environmental impact of concrete production and provide a sustainable alternative to traditional coarse aggregate.

Keywords: Hemp Shives, Aluminium sulphate, Calcium hydroxide, Fly ash, Compressive strength, Flexural strength ,Split tensile strength, water penetration depth, sorptivity.

Paper ID 641

Study on Self-healing Properties of Bacteria based Cement Mortar with Eggshell Powder and Jute fibre

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The work explores the experimental investigation of Bacillus paramycoides bacteria with the concentration of 105 cells/ml in cement mortar cubes. To study the strength and durability properties of cement mortar, Eggshell powder (ESP) was used as cement replacement in three different percentages of 5%, 10%, 15% and jute fibre was used with constant dosage of 0.5% in volume fractions. In this study ESP was used as nutrient source and jute fibre as a carrier material to enhance the healing efficiency of bacteria concrete. Eight mixtures were prepared and divided in to three series: control (no bacteria, ESP, and fibre), with and without bacteria including the eggshell shell powder and fibre. For all mixtures, mortar cube specimens were prepared for 7, 14 and 28 days to determine the compressive strength. Compressive strength regains, healing efficiency and durability properties such as water absorption and sorptivity was studied for uncracked and pre0cracked specimens at different days under full wet curing. Based on the test results, notable strength improvement and rate of crack healing was observed for all fibrous mixtures with bacteria and ESP than control mixes. Microstructure study such as Scanning Electron Microscope (SEM) and X-ray diffraction (XRD) was investigated for different mixtures to composition of elements formed in calcium carbonate precipitation.

Keywords: Bacteria concrete, Eggshell powder, jute fibre, strength, durability, and healing products

Paper ID 650

Performance Analysis of Fixed and Seismic Base Isolation System for Multi-Story Building

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This paper focuses on the implementation and effectiveness of a base isolation system for reinforced concrete structures during seismic events. The study presents a 3-D reinforced concrete frame building with rubber bearings as a case study, using SAP 2000 software for modeling and analysis. Seismic load calculations are performed according to IS 1893-2016 to meet earthquake-resistant criteria. This study examines a 3-D reinforced concrete frame structure with dimensions of 21m on the x-axis and 21m on the y-axis, comprising a G+6 configuration with a height of 24m.The objective is to increase the natural time period, reduce storey drift, and lower the acceleration response of seismic events. The paper evaluates the effectiveness of the base isolation system in terms of maximum shear force, maximum bending moment, base shear, storey drift, and storey relocation reductions. Furthermore, the paper discusses the generation of the flooring spectrum or response spectrum by analyzing the structure through time history analysis. The findings highlight the potential benefits of base isolation systems in mitigating the detrimental effects of seismic events on buildings.
Keywords: Sap 2000; Base isolation; Rubber bearing; Time history analysis.

Paper ID 666

Studies on Performance of Light Weight Geopolymer Concrete by utilizing by-products from Steel and Alumina industry as the Binder Material

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This project focuses on the experimental investigation of the performance evaluation of lightweight geopolymer concrete using red mud, ground granulated blast-furnace slag (GGBS), cinder, pond ash, and m-sand. The study examines the material characteristics, mechanical properties, durability, and microstructural characteristics to understand the behavior of the produced geopolymer concrete. Various tests were conducted to examine the material characteristics, mechanical properties, and durability of the geopolymer concrete. The compression test was carried out with different alkali binder ratios, and it was found that a binder ratio of 0.4 resulted in the maximum compressive strength of approximately 25 MPa. The proportion of binders was also varied, and it was observed that a combination of 40% red mud and 60% GGBS achieved a compressive strength of 25 MPa. Furthermore, temperature curing was performed on the produced geopolymer concrete. At 80ºC the optimum compressive strength obtained under this temperature was 22 MPa. The results of this research offer important information about how lightweight geopolymer concrete behaves.
Keywords: Light weight aggregate, geopolymer concrete, binders, red mud, pond ash, cinder.

Paper ID 670

Effective Utilization of Eco-friendly Industrial Waste and by-products in Ferrocement Slab Panels

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An effort has been made to examine the flexural performance of ferrocement rectangular panels using geopolymer mortar consisting of fly ash and Ground Granulated Blast Furnace Slag as the base materials. River sand and M -sand served as fine aggregates for the mortar. Hydroxides and Silicates of Sodium served as alkaline activators that polymerizes the pozzolanic raw materials. For the designed mortar mix, the workability and compressive strength were deter-mined using the standard test protocols. Ferrocement panels were cast using lay-ers of fibre glass mesh and welded wire mesh (single, double, and triple layers of same type of mesh) and using hybrid layers (one type of mesh sandwiched be-tween the other type) and subjected to test under flexure. Characteristics like ultimate load, Load versus deflection, ability to absorb energy and failure patterns were explored. Ductility enhancement is evident in welded wire mesh slabs in comparison to fibre glass slabs. Slabs with welded wire mesh have enhanced load carrying capacities and energy absorption than the fibre glass mesh reinforced slabs. Irrespective of type of sand and mesh, the ultimate load carrying capacity increases with the number of layers of mesh. In hybrid type, slabs with double welded wire mesh layers is superior with higher load carrying ability and ductility when compared to that of slab reinforced with double fibre glass mesh layers.

Keywords: Geopolymer, Fly ash,Ground Granulated Blast Furnace Slag, Flexural strength,Energy absorption.

Paper ID 678

Effectiveness of Concrete Jacketed Reinforced Concrete Frame Subjected to Non-Linear Static Analysis

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To strengthen the existing vulnerable buildings, a variety of strategies and methods have been researched and put into practise recently. Stiffening already-existing structures and/or enhancing irregularities or discontinuities in the stiffness or strength distribution of a building are a few of them. Providing increased strength for the existing structures is the most promising job and to define a suitable strengthening technique needs a technical evaluation. RC (Reinforced Concrete) Jacketing is amongst the earliest and the most popular techniques used to retrofit or strengthen RC columns. In this paper, the seismic response of a 5 storey RC frame building before and after Reinforced concrete jacketing have been analyzed by adopting an incremental non-linear static analysis. Furthermore, change in ductility capacity and elastic stiffness has been evaluated with help of the obtained pushover curve and FEMA 356 coefficient method. The Elastic stiffness for both i.e., the original and the jacketed frame has been calculated by finding out the slope of the elastic region in the pushover curve. The capacity curve obtained from the analysis done in SAP2000, the behaviour of the frame was observed to be linear up to some initial values of base shear post which the frame displayed non linearity. It was also observed that after jacketing the columns of the frame, the load carrying capacity of the building has been increased tremendously. Similarly, the roof displacement also showed a significant increase.

Keywords: Columns, Retrofitting, Jacketing, Pushover analysis, Hinges.

Environmental Engineering

Paper ID 012

Trends and Environmental Impact of Paper Consumption: A Prognostic Scenario for the Indian Market by 2030 - A Case Study

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This article examines and reports on the trends and environmental impact of paper consumption in India, with a focus on the period up to 2030. To forecast future levels of paper production and consumption across various industries, the research analyzes historical data patterns. The study finds that the paper industry is responsible for a significant amount of environmental damage, including deforestation, air and water pollution, and climate change. If measures are not taken to reduce our reliance on paper, the study predicts that paper production and consumption will continue to increase at an alarming pace, which could have detrimental effects on the environment. The report recommends encouraging sustainable practices such as recycling paper, using recycled paper, and decreasing overall paper consumption. Additionally, the study emphasizes the need for increased awareness among individuals and organizations about the environmental implications of paper use. The report proposes implementing legislation to ensure responsible paper production and use. Finally, the study highlights the importance of reducing paper dependence to protect the environment and preserve natural resources for future generations.

Keywords: Paper consumption, Environmental impact, Trends, Sustainability, Resource conservation.

Paper ID 032

A Review on Life Cycle Assessment in Silk Textile Industry

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Use of green material in textile industries is a need for sustainable production. Life cycle assessment (LCA) of silk textile industry is performed from manufacturing of silk, which starts from its extraction to overall lifespan of the silk fiber. The LCA results will help to quantify the overall impacts related to resource depletion and major reduction of other adverse effects on the environment. The Silk based textile industries are one of the greatest sources of environmental degradation. To control this pollution a subsection of silk industries came into existence known as spun silk which use waste products from various stages at the time of production of silk which is referred to recycling of waste material of silk. Environmental contamination, less efficiency in production, wastage in material and over usage of energy are some of the major issues due to which spun silk sector is currently dealing with. This review presents an eco-friendly approach for the production of mulberry spun silk fabric by the elimination of hazardous environmental impacts. Silk industry pollutes our natural ecosystem by discharging waste like dust, odors, gases, huge amount of material is wasted and production cost is also very high. The new process of utilizing silk waste reduces carbon emissions, material wastage and also lot of energy in the entire process which is a very big achievement in the production of spun silk fiber. In this paper, comparative analysis is done between silk and cotton fiber to evaluate which fiber plays a more effective role in atmospheric degradation.

Keywords: life cycle assessment, silk fibers, sustainability.

Paper ID 038

Feasibility study on application of soft computing algorithms for salinity intrusion mapping

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In recent years, salinity intrusion is a major concern in coastal regions due to the increase in demand for groundwater. However, monitoring and estimating the status of saltwater intrusion is a challenging task. Nowadays, the application of soft computing approaches gaining potential in engineering problems because of the rational structure and capable of analyzing non-linear problems. Saltwater intrusion is a key factor to assess the quality of groundwater, particularly in inland aquaculture areas. This paper presents aims to provide a detailed review study on the potential application of soft computing techniques to assess saltwater intrusion. Soft computing techniques such as artificial neural networks (ANN), support vector machine (SVM), random forest (RF), particle swarm optimization (PSO), fuzzy logic (FL), and genetic algorithm (GA), show desirable prediction results and to some extent replaces the tradition regression models.

Keywords: ANN, salinity intrusion, regression model, aquaculture

Paper ID 087

Assessment of The Carbon Footprint of Green Concrete Liners in Landfill Construction Critical Review

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This paper presents a critical review of the existing research on the assessment of the carbon footprint of green concrete liners used in landfill construction. The review assesses the current understanding of the carbon footprint of green concrete liners and the key factors that affect the carbon footprint, including the materials and production processes used to manufacture these liners. The review is based on a systematic literature search, which identified and reviewed a total of 28 papers. The papers included studies that examined the carbon footprint of green concrete liners from the cradle-to-gate stage, and from the cradle-to-grave stage. The review also identified potential areas for further research in order to improve the current understanding of the carbon footprint of green concrete liners. The results from the review indicate that the carbon footprint of green concrete liners depends on the materials used, their production process, and their service life. Furthermore, the review revealed that the current research on the carbon footprint of green concrete liners is limited and further research focusing on the service life and the end-of-life stage of these liners is needed in order to develop a robust assessment of the carbon footprint of green concrete liners.

Keywords: Carbon footprint, Green concrete liners, Landfill construction, Sustainable construction.

Paper ID 088

Mathematical Models in Forecasting Air Pollution: A Review

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Air is an essential source for the presence of life on the earth; however, air quality has seriously been affected worldwide because of several sources. Air pollutants are dangerous that can cause serious health issues to humans, even at very low continuous concentrations. Hence, it is important to forecast different air quality parameters to protect the environment, and several mathematical models have played an important role in it. In this review article, some such mathematical models have been introduced briefly.

Keywords: Air Pollution, Pollutants, Mathematical Models.

Paper ID 090

Water Quality Analysis of Borewells for Drinking Purpose in selected wards of Tumakuru City Corporation Limits

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A Study was undertaken to assess the quality of water of borewells for human consumption in Tumakuru city corporation limits utilizing Water Quality Index (WQI). 45 borewell water samples were procured from six wards during January-June 2022. The collected samples were tested for nine parameters namely, pH, Acidity, Alkalinity, Total Hardness, Calcium, Magnesium, Chloride, Sulphate and Nitrate as per IS code provisions. It was found that 37.7% samples are satisfying the standards and 62.3% samples are not meeting the standards as per the WQI classification. Higher WQI was observed due to higher value of Alkalinity, Total hardness, Chloride, Calcium and Magnesium content present in the borewell water. The test results showed that the groundwater sources need to be treated before consumption and also sources have to be protected from further contamination. This study helps in protecting groundwater sources and its management in future.

Keywords: water quality index, borewell, resource, contamination, wards.

Paper ID 102

Treatment of College Canteen Sullage Using Microcosm Phytorid System

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Wastewater is commonly characterized as 'sullage' and 'blackwater', the sources of which are wastewater generated from residences, hotels, restaurants, canteens, etc. Sullage also requires treatment as it contains huge amounts of organic matter, salts, oil, grease and also sulphates and phosphates due to the usage of detergents. Phytorid is a self-sustainable technology for sullage treatment that works on the principle of natural wetlands. In this study, the treatment of college canteen kitchen sullage water is carried out using Phytorid technology, by using a pilot scale reactor setup in which plants like Canna Indica, Moses in the cradle, Spider plant, Golden Duranta and Beach spider lily are planted in separate containers filled with layers of gravel (bot-tom), sand (middle) and garden soil (top). The effluent from all five containers including the control was tested for the same parameters after 7, 14 and 21-day intervals. The characterization of the sullage sample from the college canteen kitchen had pH ranging from (6.98 to 7.80), electrical conductivity (1560 to 1600 µS/cm), TDS (1150 to 1210 mg/L), Chlorides (345.43 to 387.50 mg/L) Phosphates (12.43 to 13.63mg/L), Sulphates (136.25 to 142.1 mg/L), BOD (398 to 416 mg/L) and COD (489 to 535mg/L). Beach spider lily showed higher reduction efficiency for Electrical conductivity (15.94%), Chlorides (87.68%) and Phosphates (79.43%). Spider plant showed higher reduction efficiency for Sulphates (38.69%), TDS (30.17%) and COD (75.05%) whereas Golden Duranta was efficient in reducing BOD (88.94%). All these plants were efficient in neutralizing the pH. From the study, it can be concluded that a phytorid system consisting of Beach Spider lily, Spider plant and Golden Duranta will be efficient in reducing the physio-chemical parameters of sullage.

Keywords: Sullage treatment, phytorid system, reduction efficiency, TDS, BOD

Paper ID 137

Analysis of Physicochemical Composition of Water Samples from borewells located in and around Kadur area, Chikkamagaluru dist, Karnataka, India

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Water is a precious natural resource which is required for survival of living things. Groundwater is a major source for a large range of beneficial uses. It is a vital parameter of the economy and the environment. Recent studies shows that groundwater is over-exploited and polluted to the maximum level in Karnataka state. Groundwater quality determination is required in present context. In the study, Groundwater samples were collected from particular places of Kadur area. These water samples from 10 sampling points of Kadur area were analyzed for their physicochemical characteristics. Laboratory tests were performed for analysis of samples for 12 parameters such as pH, Total dissolved solids, Total Hardness, Electrical Conductivity, Total Alkalinity, Calcium, Magnesium, Chloride, Fluoride, Nitrate, Sulphate and Iron. On comparing the results with water quality standards BIS 10500:2012 and World Health Organization (WHO). It is found that except total hardness, calcium and magnesium concentrations, rest considered parameters were within the Permissible limit of standards for all the 10 samples. Groundwater of the study area is considered as fit for drinking purpose and needs certain degree of treatment atleast softening and disinfection. The results of all the findings are discussed in detail which reflects the present status of the groundwater quality in the study area.

Keywords: Groundwater, Water Quality Characteristics, Water Quality Standards.

Paper ID 148

Efficiency of Constructed Wetland in Landfill Leachate Treatment Using Different Filler Materials: A Comparative Study

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Due to the complex composition of landfill leachate and the high cost of conventional wastewater treatment, it is quite difficult to treat landfill Leachate (LL) and suggest a suitable technology. Using a low-cost project of constructed wetland (CW), an artificial system that mimics a natural wetland used for LL treatment. CW is an engineered system that treats various waste streams, including landfill leachate and removes pollutants. The present study aims to compare the removal efficiency of selected pollutants from landfill leachate in CW using different types of filling. The landfill leachate and clay were collected from the solid waste management plant of Nasik,(MH) India. The laboratory vertical constructed wetland set-up was developed in the; laboratory using a combination of substrates, i.e. gravel, sand, organic substrate (pine bark) or mineral matter (zeolite, expanded clay), and the plants used are canna indica. The material was selected for the suitable climatic conditions in the Indian scenario. The various physicochemical parameters and heavy metals of treated and untreated landfill leachate were determined. The pollution reduction and removal efficiency was evaluated. The laboratory conduction investigated the CW reductions were found total Phosphorus (TP) - 96%100%, Total Nitrogen (TN) 50-84%, Nitrogen Ammonia (AN) 65-93%, Sulphide 70-90%, and chloride 10-30%. COD 40-50%, BOD5 30- 70% and heavy metals - (Zn, Cu, Pb, Cd) 50%-60%. The results show that the best removal efficiency is obtained using clay filler material for most parameters.

Keywords: Landfill leachate, Constructed wetlands, canna indica, physicochemical parameter, heavy metals

Paper ID 216

Evaluation of Solid Waste Management in Rural Areas of Udupi, Including an Adaptation Strategy

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Rural India is facing a massive waste disposal problem which will worsen in the coming years. With increasing population and economic inflation, the lifestyle of rural residents / households is changing. Thus Solid Waste collection, disposal and management have become a major rural problem especially in the populated cities. Three Gp's were selected as study areas. In the respect characterization study in 3 these villages are either non-existent or insufficient, steps carried out in engineering way from collection, segregation at the source, transportation and final into disposal. Daily segregated waste collection, dry waste sorting and wet waste processing data was captured of 3 Gram Panchayat for 3 month, based on the average of different data's captured for 3 month average waste generation from household and commercials in the Gram Panchayat were calculated. All incoming unsorted waste will be stored temporarily at the unloading area near the SWM unit. EPR products like Tetra Pak and PET bottles will be moved immediately from unloading area to their respective storage area. The result showed that percentage of visual cleanliness will be drastically altered with the management of SW and intern effects in the economical environmental aspects of the villages.

Keywords: Solid waste Management (SWM), Extended Producer Responsibility (EPR) Disposal, Segregation.

Paper ID 239

Design and Development of Greywater Treatment System for Urban Households Using Red Soil and Aggregates as Filter Media

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Water is an indispensable constituent of everyday life. With rapid growth in global population, there is a wider gap between the demand and supply for fresh water. Hence there is a great need for appropriate water management practices. Rain water harvesting and greywater recycling are emerging as new techniques in water management practices. It comprises of waste water generated from kitchen sinks, hand wash basins, showers, and household appliances like washing machines or dishwashers. Greywater varies from 50-80% of the wastewater volume generated by households. Literature review revealed that recycled greywater can be reused for toilet flushing, gardening, landscaping, washing cars etc. This paper presents the finest design and fabrication of laboratory scale greywater treatment model, which is a combination of anaerobic and aerobic treatment processes. The working and performance of greywater treatment plant was observed. The raw and treated samples were analyzed in the laboratory to check its efficiency and achieved efficient removal rates: turbidity (96%), COD (91%) and BOD (90%). Based on the model studies, a typical greywater treatment system has been proposed for urban households.

Keywords: Greywater treatment plant, effluents, BOD, COD, turbidity.

Paper ID 251

Groundwater Quality Assessment of Hubballi City, Karnataka, India by using CCME, WAWQI & Geospatial Techniques

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Groundwater quality assessment is a very useful approach for assessing water quality and it provides an understanding of the suitability of groundwater for various purposes, especially for drinking water. Safe drinking water availability is of utmost importance. The groundwater quality is deteriorating at an alarming rate due to improper disposal of wastewater from society and industries. This work aims at assessing the groundwater quality of Hubballi city, fast-developing cities of North Karnataka with respect to growing population and industrialization. Hubballi city is classified into seven different zones with 26 sampling stations. Groundwater samples from these identified stations for both pre-monsoon and post-monsoon seasons are analyzed for physiochemical variables such as pH, electrical conductivity, total hardness, alkalinity, chloride, sodium, potassium, nitrate and Fluoride. Water quality index was obtained using Canadian Council of Ministers of the Environment (CCME) Method and Weighted Arithmetic Water Quality Index (WAWQI) Method and further spatial distribution maps are created using IDW tool in GIS. Based on the water quality indexing techniques the water quality of the whole area is categorized as excellent, good, poor, very poor and unfit for consumption. The stations with poor water quality need attention with respect to groundwater quality before consumption.

Keywords: Groundwater quality, Hubballi city, CCME, WAWQI, Spatial distribution maps.

Paper ID 310

Comparative Analysis of Landfill Gas Emission Models: Methane Recovery Rate Estimation

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Rapid growth in populations and industrialization have a direct impact on the environment, causing generate increased solid waste generation rate. Municipal solid waste (MSW) landfills are the third-largest source of methane emissions. The uncertainty in projecting landfill gas (LFG) generation rates is a significant challenge in assessing the performance of LFG collection and LFG to energy facilities. The present study aims to estimate methane emissions from the municipal solid waste landfill in Nashik City for 50 years from 2000 to 2051. The Belgium, landGEM, Scholl canyon, TNO, and German EPER models were used to estimate the methane generation rate and compared for accuracy. The LFG emission models are based on input data such as methane production rate, potential methane production capacity, waste acceptance rate, waste generation, collection efficiency, decay rate, time of waste disposal, and rainfall rate. According to the results, solid waste production increased by 12103.4 tons to 394085.5 tons over 50 years. Total methane gas produced from 2000 to 2051 was obtained to be 230, 53848, 538481,430,445 Mg/year by the Belgium, landGEM, Scholl canyon, TNO, and German EPER models, respectively. The results showed that the maximum methane production rate by the Scholl Canyon model and its overestimated, which could be an unrealistic assumption. The LandGEM model shows a high emission rate compared to the other three models. The TNO and EPER-German models show the best possible emission rates; the Belgium model also provides a moderate methane emission result. This result variation is affected by model parameters, methane generation potential and its generation rate constant k, insensitive to the approach in quantifying the parameters.

Keywords: Municipal solid waste, waste generation, methane, Landfill gas estimation models.

Paper ID 363

Optimization of the Dosage of Supporting Electrolyte for Treating Coffee Pulping Wastewater by Electrocoagulation

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The present work deals with the application of electrocoagulation in batch mode for the treatment of coffee pulping wastewater containing biodegradable organics that includes high COD, ammonia nitrogen, nitrate and phosphate. Samples were treated using electrocoagulation by studying working parameters such as current density (20–80 A/m2), electrode distance (1cm) and initial pH (3.6–8.7). Optimization of the polyelectrolyte was done by varying the dosage from 0.5 g/L to 2.5 g/L to generate more flocs during the electrocoagulation. The concentration of COD was reduced from 7742 mg/L to 413 mg/L in 90 min, while other parameters including ammonia nitrogen, nitrate and phosphate reduced from 34.4mg/L, 26.5 mg/L and 29.2 mg/L to nearly Below Detection Level (BDL) respectively with the usage of optimized dosage of supporting electrolyte by the end of 90 minutes of electrolysis.

Keywords: Coffee pulping wastewater, Electrocoagulation, Biodegradable organics, Supporting Electrolyte

Paper ID 366

Multivariate Statistical Approach for Assessment of Surface Water Quality in The Intensive Inland Aquaculture Region in India

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The western Godavari delta region of Andhra Pradesh is India's major inland aquaculture zone; this ecosystem relies on the dense network of canals. The Venkaya-Vayyeru canal is the most significant aquaculture catchment-dependent canal stream. It is a drinking water source used for aquaculture and agricultural irrigation in the western Godavari delta region of Andhra Pradesh, India. As a result, the canal's water quality is crucial. In this study, untreated home sewage, aquaculture effluents, and agricultural runoff are some of the various stressors used to assess the canal's water quality. Eight water quality metrics were tracked for this over a year at three distinct places along the canal. Most metrics displayed significant geographical variation, demonstrating anthropogenic influence. However, due to extensive inland farming ponds and insufficient water flow, all parameters exhibited a similar pattern throughout the year. Three sites were divided into three groups by cluster analysis: clean, low polluted, and highly clean regions. Salinity, ammonia, and Ca^{2+} were found to be the main factors causing changes between the regions by stepwise temporal discriminant analysis. According to principal component analysis (PCA) and factor analysis, aquaculture effluents, soluble salts, nutrients, and organic matter were shown to be the critical criteria responsible for differences in water quality.

Keywords: ammonia, aquaculture, principal component analysis, water quality

Paper ID 370

Sustainable Utilization of Rambutan Peel for Wastewater Treatment

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Worldwide, the growing population and increased industrialization and agricultural production require more and more water of adequate quality. Chemical and biological wastewater treatments are very effective, but the methods are costly or complicated, and long-term use of chemicals is likely to develop various health effects. Therefore, developing a much cheaper, simple, and environmentally friendly method for better wastewater management is imperative. The use of natural coagulants which contain protein in wastewater treatment has been discussed for a long time. Rambutan (*Nephelium lappaceum*), native to Southeast Asia and belonging to the Sapindaceae family, is a potential fruit widely grown in Malaysia, Thailand and other Asian regions. However, Rambutan rind usually is thrown away as waste. Interestingly, the rind of Rambutan fruit has higher protein content, antioxidant property, and other essential nutrient activity than their pulp fractions. Rambutan seed was already proven to be a coagulant. Rambutan rind powder has been applied to a wastewater sequence comprising coagulation-flocculation-sedimentation-filtration. It revealed that 30 g/l of Rambutan rind powder with less than 75µ size removed up to 99% turbidity. It was also observed that the wastewater properties such as pH, hardness, chloride, COD, and DO were within the permissible limit as per IS 10500:2012 after Filtration. The Percentage removal of BOD and COD is around 98%. These studies have shown that the Rambutan rind powder is highly effective in treating wastewater.

Keywords: Wastewater, Rambutan rind, waste waterer treatment, coagulants

Paper ID 426

Artificial Neural Networks Modelling for Predicting Water Quality in The Surface Waters of Western Godavari Delta, India

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Many human activities have been the main contributors to surface water contamination in recent years. However, the western Godavari delta region of Andhra Pradesh only seldom permits assessing the water quality's natural state due to the uneven distribution of industrial operations and agricultural farms. This study uses artificial neural networks (ANNs) to estimate surface waters' water quality index (WQI) between 2014 and 2022. A prediction like this can reduce computing time, labour, and the chance of calculating errors. The ANN results demonstrate that convergent plots perform better when the coefficient of determination (R^2) values are more significant. Electrical conductivity (EC) and total dissolved solids (TDS) are the most significant parameters in predicting WQI in the surface waters of the Godavari delta region, according to a sensitivity analysis used to demonstrate the significance of each parameter in the ANN's modelling process. The method described in this paper offers a practical and effective alternative to WQI assessment and prediction, particularly when compared to WQI calculation methods that require time-consuming calculations and multiple sub-index calculations for every single value, or range of standards, of the part water quality variables.

Keywords: aquaculture, ANN, water quality, ammonia

Paper ID 543

Prediction of Inland Aquaculture Ammonia Using Hybrid Intelligent Soft Computing

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One of the crucial factors in assessing the pond's intensive inland aquaculture water quality condition is ammonia. The excessive ammonia content is likely to worsen water quality and result in the mass mortality of cultured individuals. For aquaculture management, it is therefore vital to accurately identify the ammonia nitrogen level of cultured water. However, the accuracy of technology for monitoring the ammonia content of aquaculture water is currently insufficient to satisfy the demands of intensive aquaculture. This paper first predicts the ammonia concentration of aquaculture water in real-time using a hybrid intelligent soft computing algorithm. Radial basis function neural networks (RBFNN) and a hybrid model combining RBFNN, and particle swarm optimization (PSO) are used in this technique. Root mean square error (RMSE) and correlation coefficient (R^2) were two separate statistical metrics used to compare the two methodologies and assess how well the soft computing strategies performed. The ammonia prediction results showed that the PSO-RBFNN soft computing method outperformed the RBFNN. The PSO-RBFNN model offers a real-time ammonia prediction value in inland farming waters that is moderately and generally accurate.

Keywords: Aquaculture, ammonia, RBFNN, soft computing

Applications of IoT, Machine Learning & Artificial Intelligence in Civil Engineering

Paper ID 024

IoT-Enabled Monitoring of Prefabricated Drain Performance for Ground Improvement- A review

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Parul University

Prefabricated vertical Geodrain (PVD) is a ground improvement technique used to improve the soil's strength and reduce its compressibility. PVDs are installed vertically in the ground and are made of geotextile or geocomposite materials. The use of IoT in PVD installation and monitoring can help optimize the technique's performance and ensure that the desired level of improvement is achieved. Prefabricated drains are a popular ground improvement technique used to improve the strength and drainage characteristics of soil. However, the performance of prefabricated drains can be affected by various factors, such as soil properties, installation methods, and environmental conditions. To optimize the performance of prefabricated drains, it is important to monitor their performance in real-time and make adjustments as necessary. In this paper, we present an IoT-enabled monitoring system for prefabricated drains that can provide real-time data on drain performance and soil behaviour. The system includes sensors that can measure parameters such as soil moisture, pore water pressure, and drain flow rate. The data collected by the sensors is transmitted wirelessly to a central server where it is analyzed and used to optimize drain performance. We also present a case study of the application of the IoT-enabled monitoring system to a prefabricated drain installation in a construction site. The results of the case study demonstrate the effectiveness of the monitoring system in improving the performance of the prefabricated drain and reducing construction costs.

Keywords: Prefabricated drain, ground improvement, IoT, real-time monitoring, soil behavior, construction site, wireless sensors.

Paper ID 101

Prediction of Noise Pollution of Delhi City using Machine Learning: A case study

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This paper discusses the prediction of the noise pollution during Deepawali festival of Delhi City using machine learning (ML) algorithms. The spatial noise pollution data of four locations of Delhi namely Lajpat Nagar, Mayur Vihar-II, Kamla Nagar and Pitam Pura were collected from the Central Pollution Control Board (CPCB). Seven regression models were used on the Python platform. Algorithms were run using the Google Colab. As the data obtained was very less, additional two random data were generated and used in the analysis. It was found that amongst all models, Quantile Regression is a superior one in the prediction of noise level in the present study as compared to other ML models. It is observed that coefficient of determination with Quantile Regression is 0.792 for original data, 0.803 for 150 random data and 0.801 for 300 random data. However, at other location, the suitability of a particular regression model can be determined and recommended.

Keywords: Noise Pollution Data, Python, Machine Learning, Regression Models.

Paper ID 103

Building Surface Crack Detections using Deep Convolutional Neural Network (DCNN) Architectures

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This paper discusses the most common structural defect in concrete is surface cracking. Building inspections are conducted to evaluate a building's rigidity and tensile strength. In the process of inspecting a building, crack detection is also an important aspect, as it helps find cracks and determine the condition of the building. Several deep learning models like VGG19, VGG16, and MobileNetV2 have been fine tuned to identify surface cracks using Tensorflow. In the datasets, there are 40000 images of different concrete surfaces, both cracks and no cracks, with 227 x 227 pixels and RGB channels. VGG16 is a Convolution Neural Network (CNN) architecture with an accuracy of 99.62% which is observed as one of the most advanced vision model architectures. In Deep Learning (DL), Dense Convolutional Network (DenseNet) is an architecture used to create deep networks. By distributing the weights of the features collected from deeper layers over a number of inputs present in the same dense block and transition layers, 99.51% test accuracy can be achieved. There is a great deal of similarity between the VGG-19 architecture as well as VGG-16, which has been tested with an accuracy of 99.62%. The MobilenetV2 has achieved an accuracy of 99.81%.

Keywords: DNN, CNN and Surface crack detection.

Paper ID 104

Soil Moisture Detection Using Arduino Sensor and ANN Prediction

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Appropriate soil moisture content is a pre-requisite for optimum plant growth. Irrigation process is a dominant consumer of water, which necessitates the regulation of water supply. Fields should neither be over-irrigated nor under-irrigated for best yield of crops. Hence, the smart system of detecting the existing moisture content of soil along with irrigation system controllers is the need of an hour. The present study focusses on the on-board installation of soil moisture sensor with Arduino UNO platform to measure the moisture content of soil samples, which will facilitate in releasing of irrigation water. The present experimental study uses five uniform (poorly graded) soil samples of size d50 = 850μ, 600μ, 425μ, 300μ and 150μ and a non-uniform (well-graded) soil sample of d50 = 325μ. The sensor readings are used to measure the degree of saturation of the soil and in turn estimate the existing moisture content of the soil sample. Further, power equation is developed between the sensor reading and the moisture content of the soil with an R2 value of 0.96. In addition, various prediction models are employed and compared. It is found that artificial neural network predicted the moisture content better than other predictor having prediction accuracy with R2 = 0.986.

Keywords: Soil moisture, Sensors, Arduino, Microcontroller, Artificial Neural Network.

Paper ID 124

Conventional and Ensemble Machine Learning Techniques to Predict the Compressive Strength of Sustainable Concrete

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Oil palm shells (OPS) can be utilized as a sustainable substitute for natural coarse aggregates in the making of concrete. OPS has various advantages over natural coarse aggregates in concrete manufacturing, including environmental sustainability, lower density, good insulating qualities, lower cost, and a lower carbon footprint. However, in addition of its many benefits, OPS has some limits in terms of mechanical characteristics, although it can still be a viable alternative to natural coarse aggregates in some applications. The use of appropriate additives, as well as proper design and mix proportions, can help to optimize the mechanical characteristics of concrete containing OPS. To optimize mix design, anticipate mechanical characteristics either an exhaustive set of experiments or soft computing techniques are required. To that objective, various soft computing techniques were used in this study. Firstly, a correlation matrix between various features of sustainable concrete was established. Machine Learning (ML) models were developed for predicting the com-pressive strength (CS) of concrete containing OPS. Various ML models such as Decision Tree was developed as a Conventional Machine Learning (CML) model, whereas Random Forest, AdaBoost, and Gradient Boosting were developed as Ensemble Ma-chine Learning (EML) models. Hyperparameter tuning was also performed to deter-mine the best values for the hyperparameters depending on the model's performance. All developed models predicted the CS of concrete containing OPS effectively. Models were examined using performance evaluation methods, and it was found that the Gradient Boosting model was to be the best predictor of the CS of concrete containing OPS, while the Random Forest model was found to be inferior.

Keywords: Oil palm shell; compressive strength; sustainability; concrete; Ensemble Machine Learning.

Paper ID 141

Digital Revolution in Construction Industry: A Review

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This article provides a comprehensive overview of the ongoing digital revolution that is reshaping the AECO (Architecture, Engineering, Construction, and Operations) industry, leading it towards the C4.0 model. The C4.0 model is centred around augmented digital design, interconnected and auto-mated construction processes, as well as intelligent building operations and maintenance. The article delves into the key technological drivers propelling this transformation, including building information modelling, cloud and edge computing, IoT (Internet of Things), 5G networks. The role of these technologies in driving the digital transformation of the construction sector is highlight-ed, emphasizing the new possibilities they bring in terms of enhanced productivity and building quality.

Keywords: Digital revolution, AECO industry, C4.0 model, Building information modeling, Cloud computing, Internet of Things, 5G networks

Paper ID 142

Predicting the Porosity of SCM-blended Concrete Composites Using Ensemble Machine Learning Models

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Cement manufacture is a major source of pollution in the environment as it contributes to 5-7% of total CO2 emissions globally. Quantity of cement in concrete manufacturing can be reduced by using alternative pozzolanic materials known as Supplementary Cementitious Materials (SCMs). SCMs include a wide range of materials, such as fly ash, slag, metakaolin, silica fume, nano silica, and other materials that are rich in silica and alumina. As porosity can have a significant impact on the durability and strength of the concrete. When the concrete has a high level of porosity, it becomes more susceptible to damage and also the compressive strength of concrete was reduced. To study the influence of various SCMs on the porosity, either an exhaustive set of experiments or soft computing techniques is needed. This paper presents the use of soft computing techniques as Ensemble Machine Learning (EML) models to predict the values of porosity with differing proportions of SCMs in the concrete mix. Random Forest (RF), AdaBoost (AdB) and Gradient Boosting (GB) were the EML mod-els that were developed in this study. Gradient Boosting was shown to be the best predictor of porosity, while the Random Forest model was found to be subpar after the models were examined under model efficiency parameters. For training, the Coefficient of correlation (R2), Mean absolute error (MAE), and Root mean absolute error (RMSE) were determined to be 0.995, 0.279, and 0.0.341 for GB respectively, and for Random Forest they were 0.979, 0.383, and 0.677 respectively.

Keywords: Supplementary Cementitious Materials, Porosity, Concrete, Ensemble Machine Learning.

Paper ID 145

Ensemble Machine Learning Models to Predict the Compressive Strength and Ultrasonic Pulse Velocity of Sustainable Concrete

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Currently, the concrete sector is experiencing a massive problem in adapting to the concept of sustainable development since the manufacturing of Ordinary Portland Cement (OPC) emits a substantial amount of CO2, which is responsible for global warming. Production of OPC releases about 8% of the global CO2. Thus, to reduce cement consumption, researchers are modifying conventional cement concrete by using various Supplementary Cementitious Materials (SCMs). Among various SCMs available, Fly ash (FlA) has been the most popular used SCM. The use of FlA in the concrete industry not only promotes sustainable development by reducing cement consumption but also solves the problem associated with the disposal of FlA. To study the non-linear effect of the ingredients along with the various SCM on the CS of concrete, it requires an exhaustive set of experiments which needs time, energy and money. So, in order to save our assets, soft computing techniques are needed. In this study, various Ensemble Machine Learning (EML) models such as Random Forest, AdaBoost and Gradient Boosting has been developed to predict the compressive strength (CS) and ultrasonic pulse velocity (UPV) of FlA-based concrete. Database needed to develop the various models to predict the desired outputs were obtained by the experiments performed. In order to enhance the efficiency of the models, hyperparameter tuning was being done. All the developed models were able to predict the CS and UPV of FlA-based concrete. Comparison between

the various models has been done on the basis of the model efficiency parameters and found that the Gradient Boosting was to be the best predictor whereas Random Forest to be the substandard.
Keywords: Ensemble Machine Learning, Fly Ash, Compressive Strength, ultrasonic pulse velocity, Sustainability.

Paper ID 229

Reliability Analysis of Clayey Soil Slope Stability Using GMDH and RFC Soft Computing Techniques

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Soil being a heterogeneous medium, predicting the stability of soil slope is a complex engineering problem due to the involvement of multiple effective attributes of soil in geotechnical behaviour. However, as comprehension of soil variability improves, deterministic methods have been replaced by probabilistic ones. This paper examines the application of two soft computing techniques, Group Method of Data Handling (GMDH) and Random Forests Classifier (RFC), to the study of reliability analysis of clayey soil slope stability. In addition, the applicability of GMDH and RFC in predicting stability of Soil Slope based on distinct soil attributes was evaluated, and model performance was evaluated using various fitness parameters such as RMSE, LMI, Bias Factor, etc. The results indicate that the GMDH model outperformed all fitness parameters, suggesting that the GMDH approach can be used as a reliable soft computing method for addressing non-linear problems, such as the stability of soil slope.
Keywords: Reliability, Slope Stability, GMDH, RFC

Paper ID 245

Prediction of Soaked CBR Value of Sub-base Soil Using Artificial Intelligence Model

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The objective of the research is to develop a predictive model for evaluating the California bearing ratio (CBR) value of soaked soil by using conventional and hybrid artificial intelligence models. The study used in situ soil samples from a highway construction project site and gathered relevant input parameters based on literature and database analysis recommendations. The research aims to create reliable and simple CBR models using regression analysis (RA) and artificial neural networks (ANNs) based on routine material features such as gradation, Atterberg limits, and compaction qualities. The researchers compiled a database of 197 CBR values from quality control reports of the Mid Hill road construction project in Nepal and used about 70% of the data for model construction and the remaining 30% for model validation. The study found that both RA and ANNs strategies provided high prediction accuracy for the generated CBR model in terms of coefficient of determination (R2), and the recommended model was adequately validated. The research highlights the significance of computational modelling for predicting the soaked CBR value of sub-base soil and provides a detailed comparison between the predictive ability of conventional and hybrid artificial intelligence models. The results of the study have significant implications for the field of soil testing for sub-base soil.
Keywords: California bearing ratio (CBR), artificial intelligence, statistical parameters, sub-base soil sample

Paper ID 323

Application of Internet of Things (IoT) in Seismic Performance Evaluation of 3D Printed Structure

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Conventional construction of structures consumes more time and effort but still lacks quality depending on the workmanship and generates large amounts of construction cost due to formwork. In the recent past, 3D-printed buildings have been tested only for inertial forces originated from building loads itself. The performance of a 3D-printed scaled-down building model subjected to seismic loads needs to be understood. The present study discusses about the analysis and testing of a 3D-printed scaled-down model subjected to earthquake loads using the Shake Table Study. A five-story prototype building has been scaled down using similitude laws to a scale of 1:30 and 3D printed using Polylactic Acid (PLA) material. The concept of IoT (Internet of Things) has been used in the form of ADXL335-accelerometer, NodeMCU, and Arduino UNO to measure acceleration values at different levels of the model subjected to 2001 Bhuj Earthquake loads. The recorded values are, in turn, transferred to a public cloud (ThingSpeak) which makes data handling simpler. The results obtained for the scaled model are extrapolated to comprehend the response of the prototype model in terms of displacement and acceleration. Results of the study indicate that displacement of the top storey is more compared to lower floors both in the scaled and prototype model.

Keywords: Acceleration, 3D Printing, Internet of Things (IoT), Polylactic Acid, Earthquakes.

Paper ID 390

Machine Learning Algorithms for Land-Use Land-Cover Classification

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Right now, we're in the Big Data era. The quantity of geospatial data gathered or stored using remotely sensed satellite imagery for land-use and land-cover (LULC) mapping and secondary geospatial data files grow. Innovative cloud computing, deep learning methods, and machine learning have also recently been developed. Deep learning (DL) methods have gained prominence in recent years and have emerged as the new paradigm for data processing in remote sensing research. Deep learning algorithms got a lot of interest because of their enhanced performance in separation, category, and supplementary ma-chine algorithm applications. Land-use and land-cover (LULC) are key elements of a broad range of ecological uses in remote sensing. Land-use changes occur on the geographical and spatial scale owing to the precision, development capabilities, flexibility, uncertainties, structure, and ability to incorporate existing patterns. As a result, the high performance of LULC modeling necessitates the use of a broad range of pattern modes in remote-sensing, including dynamical, statistic, and Deep Learning models. This article provides a summary of the most recent machine learning techniques that have been integrated into discussed several software programs that are used in the analysis of LULC. Basic ML and DL ideas that apply to the LULC is then explained, including their pros and cons. To address the difficult issue of identifying changes in LULC, the application of deep learning to land usage, and the categorization of the land cover using multispectral and hyperspectral images, utilize a thorough evaluation of several DL architectures and a unique framework. This re-view has clarified both their advantages and disadvantages as researched by various scholars.

Keywords: land use (LU), land cover (LC), machine-learning and deep learning, algorithms, classification

Paper ID 430

IOT Based Patrolling Robot for Construction Sites

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Risk is an integral part of the construction industry. Even a well-experienced person can be met with an accident due to the inherent dangers associated with construction sites. Any construction area needs to be secured against theft and illegal activities. To ensure the safety of the construction site it is necessary to patrol the area so that any illegal activities can be reported and corrective action can be taken against them. As such sites are usually open and exposed to multiple heavy machinery, therefore these sites are prone to accidents which may end up in the loss of life of construction workers. Patrolling of such sites by humans is not safe and demands for human less patrolling. In addition to this another concern is in patrolling the construction site situated in remote locations. Without suitable resources, security cannot be arranged. IOT Based Patrolling bots with intelligent sensors, embedded systems, autonomous control mechanisms, and mobile applications would be a ground breaking innovation in advanced security and surveillance technology. So here we propose an IOT Based Patrolling robot using Raspberry PI. This system uses cameras and microphones mounted on the robotic vehicle for monitoring any premises. The robotic vehicle follows IR based path for patrolling the assigned area and stops at particular points if any sounds are detected. It monitors the entire area and detects any unauthorized or illegal activity. It captures the activity and sends images of the situation immediately to the administrator. Thus, we put forward a patrolling robot with advanced sensors that operates vigorously and monitor unsecure areas and saves the life of construction site workers.

Keywords: Internet of Things, Sensors, Robot, Construction sites, Safety

Paper ID 432

Optimizing Sustainable Construction Materials with Machine Learning Algorithms: Predicting Compressive Strength of Concrete Composites

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This research paper presents a study on predicting the compressive strength (CS) of Limestone and Calcined Clay based concrete composites using machine learning algorithms. Limestone and Calcined Clay are promising materials to replace Ordinary Portland Cement, with the potential benefits of significantly reduced carbon dioxide emissions and lower production costs. In this study, three Ensemble Machine Learning (EML) models, Gradient Boosting, Random Forest, and AdaBoost, were employed to develop predictive models for the compressive strength of the concrete composite. The models were trained using 80% of the data and tested with the remaining data. The results showed that the developed models effectively predicted the compressive strength of concrete composite with high accuracy and consistency. The findings of this research can provide valuable insights into the development of sustainable construction materials and the use of machine learning techniques in predicting the strength of concrete composites. The assessment of model efficiency revealed that the Gradient Boosting model emerged as the optimal choice for achieving accurate CS predictions, demonstrating a superior Correlation Coefficient (R2) alongside diminished values of Root Mean Squared Error (RMSE) and Mean Absolute Error (MAE). The Random Forest model was deemed inferior with lower R2 and higher RMSE and MAE values.

Keywords: Limestone, Calcined Clay, Strength Prediction, Machine Learning Algorithms, Sustainable construction materials

Paper ID 484

Civil Engineering in Smart Integrated Agriculture for Controlled Environment using Internet of Things

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Integrated farming is the blend of agriculture, Animal husbandry, agroforestry, aquaculture, combining many activities that are interdependent on each other creating a well-developed ecosystem which demands enormous time and manual operations. Implementation of IoT technology in integrated farming elevates the intelligence of integrated farming by reducing the need for manpower and enabling automated decision making process, thereby saving substantial amount of time resulting in sustainable farming. This paper discusses civil engineering, in design and implementation of IoT based Integrated farming using Arduino Uno. The work implements interdependent ecosystem that includes vegetation, greenhouse, livestock, agroforestry, aquaculture, biogas plant. The agricultural land is planned and constructed for the required ecosystem. Further it is made smarter by interfacing various sensors from vegetation, greenhouse, livestock, aquaculture, and biogas plant to cloud through Arduino using communication module/Wi-fi. The smart integrated farming system monitors and controls 7 various vegetation parameters, 2 parameters in livestock, 3 parameters from biogas plant, 4 parameters from aquaculture either by sending SMS alert to farmer or by automated control system. The crops, livestock are chosen depending on the climatic conditions, soil type and budget.

Keywords: Integrated farming, Internet of Things, Sustainable farming, ecosystem, automated control system.

Paper ID 599

Intelligent Transport System (ITS) for sustainable mobility

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There are a vast amount of transportation modes available today like rail, bus, car, water transport, rapid transit, etc. which satisfies the daily need of passengers for travel to their destination as well as goods transport. The Intelligent Transportation System (ITS) has a huge role to complete the process of connectivity between people and the transportation system. In recent days the Intelligent transportation system (ITS) had critical demands due to its excellent characteristics. The Intelligent transportation system (ITS) has the ability to connect Infrastructure and vehicles in real time via wireless technology. Further, this (ITS) has improved with advanced technologies, giving huge benefits to the people and goods movement in a safer and more efficient way across the globe. The present conventional transport system has a huge challenge to sustainable mobility as well as creates social, economic, and environmental challenges, which includes traffic congestion, accident of vehicle, pollution, increasing cost, etc. This paper aims to address these challenges by using an Advance Intelligent transportation system, devising the methodology to incorporate more electric vehicles (EV), and creating EV charging infrastructure leading to sustainable mobility. With the development of smart cities, ITS has become more promising in mobility, especially regarding the control of carbon emissions, energy conservation, cost reduction, etc. These interns connect to the sustainability aspects like., social, economic, and environmental benefits to the people. This study compares the sustainable mobility index based on the conventional transportation system and ITS for a metropolitan city, like Bengaluru, Karnataka, India.

Keywords: ITS, Sustainability, Mobility, Electric vehicle, Infrastructure, Energy, Economy

Paper ID 630

Comparative Study of Various Machine Learning Models for Estimating Standard Penetration Test-N Value

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The Standard Penetration Test (SPT) is a widely used field test in geotechnical engineering to determine the consistency, strength, and other properties of soil. This paper presents a novel approach to predict the Standard Penetration Resistance value. Many times, due to budget limitations, time constraints and other concerns, there is a tendency to discard this test. Often N value is estimated from the adjacent site if the data is available, else it is discarded. Various studies have been carried out to determine factors such as Shear Velocity, Angle of Internal friction etc. to estimate SPT-N Value. This research is a novel approach to estimate N value of the soil with the help of various soil parameters. N value of cohesionless soil is estimated using different techniques such as Artificial Neural Networks (ANNs), Random Forest model, XGBoost model, AdaBoost model, Extra Trees, Bayesian Linear Regression, Ridge Regression, ElasticNet and Lasso Regression models. With the help of five soil parameters, namely moisture content, specific gravity, soil composition, bulk density, and dry density. The model is trained on a dataset of SPT N values and corresponding soil properties. The performance of these models is evaluated using various statistical measures and compared with the existing empirical equations. The results show that the AdaBoost regression model has given highest R2 value and accuracy of 0.637 and 84.53% respectively. AdaBoost regression model outperforms the existing empirical equations and other Machine Learning models. The proposed approach can be a useful tool for geotechnical engineers to predict the SPT-N values of soils and thus facilitate more efficient and cost-effective site investigations.

Keywords: Standard Penetration Test, Standard Penetration Resistance Value, Artificial Neural Network, Random Forest, XGBoost, AdaBoost, Extra Tree, Bayesian, Ridge, Elastic-Net, Lasso.

Paper ID 637

Human Activity Recognition in Construction Industry Using Machine Learning Pose Estimation Technique

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In many applications, including measuring physical activity, understanding sign language, and controlling full-body gestures, human position estimation from video is essential. This has the potential to be utilized for activity recognition in civil work. By accurately tracking human body posture from video, the technology can identify and classify different tasks and actions being performed by workers in construction, manufacturing, or other industries. This information can be used to monitor worker productivity, optimize workflow, and identify potential safety hazards. The proposed project is a machine learning (ML) solution for high-fidelity body posture tracking, employing current open source research that also drives the ML Pose Detection API to infer predefined 3D landmarks and background segmentation mask on the entire body from RGB video frames. The suggested method in this project achieves real-time performance on the majority of modern mobile phones, desktops/laptops, Python, and even the web, in contrast to current state-of-the-art methodologies, which rely mostly on strong desktop environments for inference.

Keywords: human activity recognition, virtual agent, pose estimation

Geotechnical Engineering & Pavement

Paper ID 003

Sustainable Implementation of Standard Geotechnical Practices to Optimize the Foundation Design of a Residential Building: A Case Study

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Every site on earth is unique in its own way. Two work sites usually do not have the same sub-soil profile with identical properties. From an engineering point of view, conducting a geotechnical investigation at any site where a structure is being constructed is essential. Geotechnical Investigation methods can be effectively employed based on the nature of construction, anticipated super- structural loads, and scope of the project. Precise and standard procedures shall be adopted to arrive at the optimal type and size of the foundation. In residential projects, where parent ground consists of loose or non-uniform soil stratifications, placing the shallow foundation on top of the engineered fill is routine. This paper presents a case study of a site consisting of 3m of compacted silty sand-engineered fill. Inconsistent standard penetration resistance (N) values were reported at the founding level across different borehole locations on the site. Due to inconsistent N values, different safe bearing capacities were reported. A raft foundation was initially planned and the philosophy of a shallow sub-structure system could not be adopted with uneven bearing pressures across the site. A root cause analysis by conducting in-situ density tests revealed nonuniform or improper compaction methods adopted at the site leading to improper densities of topsoil across the site. Proper compaction control and engineered fill construction were adopted at the site to arrive at optimal foundation dimensions. Further, the measurement of the energy transfer ratio, proper tools, and quality procedures adopted in the geotechnical investigation program added value towards sustainability in construction practice.

Keywords: Geotechnical Investigation, Shallow Foundation, Compaction control, Sustainability

Paper ID 017

Application of Ground Penetrating Radar in Infrastructure Projects- A Simulation Approach

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Ground penetrating radar (GPR) has become a fundamental tool in the realm of infrastructure projects. It is a non-destructive and non-invasive investigational technique that enables data collection in a non-destructive manner, thereby reducing the probability of errors and minimizing the cost of the projects. GPR is suitable for a wide range of infrastructure projects, including those related to geotechnical engineering and civil engineering. This paper presents an overview of the role of GPR in infrastructure projects, including its benefits, applications, and limitations. The paper also discussed simulation approach using forward modelling tools to visualize the response of GPR for various subsurface conditions. The challenges and limitations of GPR and possible approaches for overcoming them are also discussed. Finally, this paper concludes by emphasizing the key role of GPR in infrastructure projects, enhancing data accuracy, reducing errors, and minimizing project costs. In summary, GPR is a valuable asset for infrastructure project professionals, providing accurate and reliable data for geotechnical engineers and civil engineers to evaluate structural performances of the building and avoid any dangers or risks.

Keywords: Ground penetrating radar (GPR), Infrastructure projects, Non-destructive technique, Non-invasive investigation, Geotechnical engineering, Civil engineering, GPR Forward modelling, Pavement thickness measurement, Bridge evaluation, Tunnel inspection, Risk avoidance

Paper ID 028

Novel Applications of Geophysics in Structural & Geotechnical Engineering

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PARSAN Overseas Pvt Limited

Geophysics is a scientific field that studies the Earth's physical properties and processes using non-invasive techniques. With the advent of advanced geophysical investigation methods, the role of geophysics in structural and geotechnical engineering has become increasingly important. In this paper, we will discuss the key applications of geophysics in these fields, focusing on how it has revolutionized site characterization, foundation design, and hazard assessment. The accurate characterization of subsurface geology, groundwater conditions, and soil properties is crucial for any construction project. Geophysics provides a non-intrusive method to investigate the subsurface without the need for drilling or excavation. Foundation design is also one of the most critical aspects of any construction project. By applying geophysical techniques to map subsurface features, the variability and the lateral extent of soil properties can be quantified. Hazard Assessment: Natural hazards, such as earthquakes, landslides, and subsidence, can pose significant threats to infrastructure and human life. Geophysics can play a vital role in hazard assessment by helping to identify potential hazards and allowing for more effective mitigation strategies. It is important to recognize that geophysics is only one part of the overall site characterization process, and it should be complemented by other geotechnical investigation methods.

Keywords: Geophysics, structural engineering, geotechnical engineering, seismic refraction, electrical resistivity, ground penetrating radar, magnetic susceptibility, soil characterization, slope stability, foundation design, structural assessment, structural health monitoring.

Paper ID 071

Waste Plastic as Fiber Reinforcement in Pavement Quality Concrete

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The rigid pavements are the most adopted all weather pavements in India as all the ingredients are available locally and they can withstand high temperature and effect of rain more effectively than the bituminous pavements. The detrimental effect of plastic on environment is well established and a known fact. The non-biodegradable plastic is causing havoc in their disposal. Usage of fiber such as steel, polypropylene, synthetic etc. are common practice in concrete now a days. The aim of present project was to find out the effect of waste PET bottles when used as fiber reinforcement in the pavement concrete. Here an attempt was made to use waste PET bottles cut into long fibers as fiber reinforcement in the pavement concrete instead of imported costly fibers. A regular pavement concrete design of M-30 grade was carried out and cubes and beam specimens were casted to determine the compressive and flexural strength respectively. The same mix design was used and the commercial fibers were added at 1.2% by weight of cement weight. In other two mixes, 1.2%, and 2.5% of PET fibers were used and specimens were casted. The test results of each trial were compared with the conventional mix. There was no considerable increase in compression strength of concrete with PET fibers when compared with control mix however about 5% increase in flexural strength was observed

Keywords: rigid pavements, pavement quality concrete, fiber reinforcement, PET bottles, flexural strength

Paper ID 084

Experimental investigation on Interrelation between hydraulic conductivity and Compressive strength of soft soil using metakaolin as stabilizer

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The building industry requires method which improves the quality of the soil, if they want the foundation to be more durable and rigid. This is especially true for residential construction. Modifying clay soils with metakaolin (MK) has proven to be an effective method for stabilizing soil. This research examined the physiochemical properties of clay soil samples obtained from a construction site. After that, the specimens were treated with different concentrations of metakaolin (0%, 5%, 10%, and 15% by weight) and placed through a series of tests in the laboratory to determine their level of strength and hydraulic conductivity. The observations showed that the hydraulic conductivity significantly decreased after the incorporation of metakaolin into the clay soil. Com-pared to unaltered soil, the hydraulic conductivity of the soil decreased by about 70% for 15% metakaolin concentration. The establishment of metakaolin-hydrated calcium silicate gel (C-S-H) in the soil matrix results in an increased pore-filling impact and smaller pore dimensions, both of which contribute to a reduction in hydraulic conductivity. The Unconfined compressive strength (UCS) of the altered soil samples dramatically improved after MK is incorporated into the mix. The UCS of the samples increased by 75% after adding the 15% MK sub-stance. The increase in UCS can be attributed to the pozzolanic interaction that takes place between MK and soil. This interaction results in the production of new saturated products, which contribute to an increase in the material's strength. The effect of the curing time on the altered soil characteristics was another aspect that was analyzed in this investigation. The authors found that soil faces continuous changes with extended curing time in strength and permeability due to the addition of MK, which is supported by the test results showing that permeability decreases and strength increases with increasing time of curing of treated soil samples with MK. Which suggests that the process of modifying the soil was ongoing because the strength and hydraulic conductivity of the modified soil in-creased and decreased simultaneously with extended curing periods. In conclusion, MK has the ability to improve the resiliency of clay soil while simultaneously lowering its permeability. According to the results of this study, altering the MK of clay soil in order to improve its mechanical and hydrodynamic properties is a strategy that can be implemented successfully and is both realistic and useful. The findings of the research can be utilized to enhance the planning and construction of geological structures such as embankments, dams, and retaining walls that are built on clay soil. This finding has significant repercussions for the construction industry because it paves the way for an alternative that is both workable and inexpensive to the earth-stabilization methods that are currently in use.

Keywords: Metakaolin, Hydraulic conductivity, metakaolin-hydrated calcium silicate gel (C-S-H)

Paper ID 105

Seismic Stability Analysis of Road Embankment Resting on Geotextile Reinforced Soft Soil

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Slope failures induced by seismic activity are critical issues related to geotechnical earthquake hazards thereby damaging various transportation corridors such as road embankments, highways and dams. This paper discusses slope stability of a 8 m high road embankment resting on soft soil under saturated conditions under the action of seismic activity analogous to 0.38g acceleration caused in seismic zone IV using equivalent linear dynamic model in Quake/W and Slope/W. Unreinforced road embankment and soft soil resulted in poor factor of safety of 1.138 and subsequently large displacements and accelerations thereby causing the simulations to be unstable. Further, the prevalence of saturated conditions yielded liquefaction zone underneath the road embankment which hold the potential of intensifying the destruction and complete col-lapse of the structure. Since the simulation yielded unsafe safety factors, based on the susceptible liquefaction zone, layers of geotextile were applied to improve the stability and effectiveness in terms of total and vertical displacements, q/p' ratio, induced accelerations, effect on total stress and excess porewater pressures were analyzed. Geotextiles proved to be effective in stabilizing the concerned simulation yielding factor of 2.813 and 1.793 pre- and post-earthquake events and declining displacements and acceleration by 33.3% and hence proved to be an effective reinforcement in minimizing seismic induced dynamic forces and enhancing the overall seismic performance of the simulation model. This research can be useful in rectifying stability related issues with similar geotechnical and prevailing seismic conditions.

Keywords: Road Embankment, Seismic Stability, Geotextile.

Paper ID 111

Numerical Analysis of Railway Formation with Geogrid Reinforced Ballast and Blanket Layer

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The Vande Bharat Express, which travels at a speed of 180 km/hr, is the high-speed train currently in operation in India. India intends to start using its first bullet train by 2026. Given that railway travel will become much faster in the coming years. The strains on India's railway subgrade component would significantly rise with the addition of high-speed railways and bullet trains. The strains may cause failure in soil that is more brittle. Utilizing geo-synthetics in the lengths of currently weak formations is an alternate strategy to reduce the number of stress. The paper investigates the importance of using Geo-synthetics(geogrids) for existing subgrade. Using the finite element software PLAXIS 3D, the vertical deformations and stresses of a railway embankment (with and without geogrid) are calculated under a moving train load of 90 kN. The speed of the moving train is taken as 180 km/hr. It also investigated the different shear stresses and shear wave velocities of moving trains at various sections. The results showed that including Geo-synthetics helped in reducing deformations and stresses to a certain level.

Keywords: Railway formation, PLAXIS 3D, Blanket layer, Ballast, Geo-synthetics, moving loads, geogrids

Paper ID 117

Laboratory Investigation of Soil Stabilization Using Terrazyme and Cement

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The process of enhancing the soil engineering properties is known as soil stabilization. The problematic soils can be improved by adding bio enzymes, and cement. In the present study a bio-enzyme named as terrazyme is used. Terrazyme is a liquid enzyme that is non-toxic and all-natural plant fermentation in its production; hence it is adopted to investigate the effect of stabilised performance in road construction. The main objective of the study was to identify the optimum dosage of terrazyme stabilized soil with cement. The dosage of cement added in percentages of 3, 3.5, 4, 4.5, and 5% by the dry weight of soils. An analysis of the physical and mechanical properties of the soil was analysed by using CBR test and UCS tests. The samples were cured and tested for 7, 14, and 28 days respectively. The results were concluded that the optimum dosage of 4.5% along with cement gave maximum strength for terrazyme 5x chemical, 5% along with cement gave maximum strength for terrazyme 11x chemical, and hence bio-enzymes chemical like terrazyme can be used for soil stabilization in problematic soil.

Keywords: Soil stabilization, cement, terrazyme, California bearing ratio (CBR), Unconfined compressive stress (UCS).

Paper ID 121

Geotechnical Behavior of Expansive Soil Reinforced with Fibre

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Considered as one of the notorious soil category as of swelling, shrinkage and cracking behavior eventually damaging civil engineering structures instigating wide-ranging difficulties for construction purpose. Over the years, Lime treatment has been broadly used to reinforce the soil but then again it comes with the unscrupulous effects on the soil such as carbonation or sulfate attack. This paper intends to evaluate the effect of fiber reinforcement (coir & jute fiber) obtained from Jodhpur, Rajasthan in improvement of geotechnical behavior of the natural clayey soil mixed with sand along with comparison of two natural fibers in improving soil strength. The author performed direct (UCS) strength test on reinforced and unreinforced soil. Initial test were conducted on coir by varying fiber content/percentage (2%, 2.5% and 3%) and eventually on jute fiber in varying fiber content/percentage (2%, 2.5% and 3%). The present paper indicates that in both the fiber employed for reinforcement exhibited an increment in soil strength. Among coir and jute fiber content/percentage, jute seems to have shown improvement accompanied by enhanced resistance to the cracking. Thus, natural fiber could possibly prevent the ill effects of soil strengthening mechanisms like lime treatment while used for soil reinforcement and conserve the already dilapidating Rajasthan's soil ecosystem.

Keywords: Jute, Coir, Fiber, UCS, Rajasthan Soil, Soil strength.

Paper ID 153

Strength Analysis of Geotextile Reinforced Subgrade

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Subgrade's poor strength is a common challenge in many road projects. Several materials are used as admixtures to reinforce the subgrade. However, geotextiles are one of the best solutions for reinforcement in the soil. In this work, an investigation of the strengths of subgrades reinforced with jute textile and polypropylene (PP) geotextile is the topic of a comparative study. On both reinforced and non-reinforced soil, tests called the Direct Shear Test (DST) and California bearing ratio (CBR) are conducted. These geotextile's positioning demonstrates how crucial it is to the subgrade's overall strength. According to the test results, jute textile (natural fibre) increased the soil sample's shear strength. Contrarily, soil's shear strength decreased when it was reinforced with polypropylene geotextile (synthetic fibre). Selecting D/2, D/3, and D/4 as the placement depths from the top surface for the geotextile. A single, double and triple layer of geotextile is used to reinforce soil samples for the CBR test. The double layer reinforcement at depths D/3 and D/4 shows optimum strength.

Keywords: CBR value, Soil, Geotextile, DST, Index properties.

Paper ID 155

Influence of Jute-reinforcement on the Stiffness Capacity of Cohesionless Pavement Geo-materials

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In this work, cohesionless pavement geomaterial reinforced with multi-layers of geo-reinforcement as jute fibres have been studied. The present work is carried out on the unreinforced soil and jute fibre reinforced soil to investigate the strength and stiffness capacity of pavement geo-materials using California bearing ratio (CBR) test. The number of layers, optimum depth and placement of the geo-reinforcement in geomaterial are investigated. The embedment depth of jute fibre, i.e., D/2, D/3 and D/4 in single, double, and triple layers have been optimised using CBR values. A novel concept of stiffness capacity along with penetration factor is introduced to evaluate the strength of the unreinforced and jute-reinforced geomaterial. The test results demonstrate that including jute fibre in single, double and triple layer increases the stiffness capacity of the soil at the optimum depth of D/4. The stiffness capacity at varied input parameter varies from 0.378 to 0.682 at maximum penetration factor which shown an 80.42 % enhancement of strength in pavement geomaterial. The outcome of the present study provides a cost-effective solution to the strength improvement in cohesionless soils for embankment, subgrade, and pavement construction technologies.

Keywords: Jute fibre, California bearing ratio, Cohesionless soil, Stiffness capacity.

Paper ID 163

A Framework for Geotechnical Engineering Practice & Education

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Today the engineering profession faces twin challenge of developing massive infrastructure as well as global issues of climate change. Projects today require complex engineering in difficult conditions with extremely tight financial, time and technical constraints. These requires multidisciplinary teams interacting closely with each other to develop safe, optimum and sustainable infrastructures. This paper discusses and outlines geotechnical knowledge required for nurturing sustainable engineering practices and their integration with existing education and training of geotechnical engineers. Starting with the main activities of geotechnical engineers including exploration, analysis and design, management and construction, the paper discusses the key sources of geotechnical knowledge such as engineering sciences, models, software, codes of practice, judgement and heuristics and their applications in engineering practice for developing a multidisciplinary talent in engineers. This is then followed by a discussion on trends such as development and incorporation of new technology, climate change and requirements of complex but sustainable projects in difficult conditions which are likely to impact the profession in the coming decades and concludes with requirements on education and training of geotechnical engineers to make them ready for future challenges. This paper attempts to bridge this gap by inculcating a better understanding of the geotechnical knowledge required in engineering practice and incorporating this knowledge in education and training of geotechnical engineers.

Keywords: Engineers, Geotechnical, Education, Practice, Sustainable, Multi-disciplinary

Paper ID 317

Stability Analysis of a Road Vertical Cut

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The impact of slope height and slope angle on the deformation and stability of the cut slopes is critical for defining road safety projects. Proposed study investigates the stability of vertical slope/cut which is existing at Moira village, Goa, India. The analyses were carried out using FEM based software PLAXIS 2D V 2023 1.0. Safety factor was found out considering three different cases 1) Existing slope; 2) Different geometric profiles with zero surcharge; 3) Different geometric profile with surcharge value. Bishop's Theoretical method was used to calculate the factor of safety of the existing slope. For Each case considered above the slope is found to be unstable. The soil shear strength properties indicate cohesion in the soil. A suitable soil with improved friction angle was used in the analysis along with a reduced height of the vertical cut to 8 m. The stability of slope was found to be greater than 1. A higher friction angle allows the soil to bear greater loads without experiencing excessive deformation or failure. This is particularly important for vertical cuts in road construction, as the soil needs to support the weight of the road and any vehicles or structures on top of it.

Keywords: Vertical slope/cut, Geometric profiles, Surcharge, PLAXIS 2D V 2023 1.0

Paper ID 170

Forsterite Treated Silt as A Liner Material

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Over time there is a natural accumulation of fine sediments and organic matter in lake beds reducing the depth and water storage capacity of these lakes. Removal of this deposited silt from lake beds is crucial to maintain the health and functionality of these natural resources. Disposing this dredged silt has been a challenge to local governments and organizations working to restore and rejuvenate lakes in their locality. The use of this silt as a landfill liner material is investigated in this paper. Landfills are engineered facilities designed to provide a safe and effective way for disposal of solid waste. The liner material should possess low hydraulic conductivity, which minimizes leachate percolation into the sur-rounding soil and groundwater. Hence, in order to serve its purpose as an efficient liner material, the hydraulic conductivity of silt has to be modified using a suitable additive. This study explores the effectiveness of magnesium-rich olivine or forsterite in reducing the hydraulic conductivity of silt. Olivine is a naturally occurring nesosilicate mineral available abundantly in the earth's subsurface. It is a sustainable and cost-effective additive that may be effective in stabilizing soil due to high amounts of MgO. Silt samples collected from two different lake beds were used in this study. Test results indicate that the hydraulic conductivity values for both the olivine-treated silt samples satisfy the minimum recommended specification of hydraulic conductivity (less than 1 x 10-7 cm/s) as per the Environmental Protection Agency (EPA) guidelines. Hence forsterite can be employed as an environmentally friendly additive that facilitates the use of dredged silt from the lake beds as a liner material.

Paper ID 302

Evaluating the Influence of Montmorillonite Content on Swelling Behaviour in Relation to its Plasticity

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Mineralogy is the major parameter to be considered while dealing with the expansive soils. The expansive soils contain different minerals and its combination, but the influence of montmorillonite content is more when compared to other clay minerals. The swelling behaviour of the expansive soils is effected by its constituent mineral content, which varies with the origin of the soils. The extent of swelling is also depend upon the quantity of montmorillonite mineral present in the soil. To manifest the relation of swelling with its mineral content, the soil sample collected from different locations in India i.e., Bhopal, Guntur, Kendrapara, Warangal, Vijayawada, Kakinada, Mysore, Raipur and Nagpur were used in the study. From the test results it was observed that the clay content and montmorillonite contents are varying with the regions. The montmorillonite content does not depend upon the clay content, the soils exhibited swelling even with less clay content due to the montmorillonite content effect. The main objective of this paper is to study the influence of montmorillonite content on swelling behaviour in reference to its plasticity (i.e., CH and CL). It is essential to know the swelling behaviour of soils to avoid infrastructural failures especially in important structures.

Keywords: Expansive Soils, Mineralogy, MMC, Plasticity, Swelling Behaviour.

Paper ID 309

Uncertainty of Measurement of Geotechnical Parameters of a Lateritic Soil

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Determination of properties of foundation soil is both an essential and indispensable part of any construction activity. However, mining of the geotechnical parameters is a challenging task requiring both a sound judgement and a vast experience. In the field of geotechnical engineering a great number of un-certainties exists due to various sources such as inherent soil variability present due to natural geological processes, measurement errors facing during testing, errors in soil sampling methods, human error, construction effects and environ-mental conditions. Therefore, the degree of uncertainty arising from sources generally depends on factors like, variability of the soil profile at the site, degree of equipment, procedural control maintained during the testing, and precision of the correlation model used. Uncertainty that are too large may affect reliability of the decision and make the situation more complex and costly. Hence, it is important to estimate measurement uncertainty by laboratories. Different methods and approaches available in the literature that have been employed to evaluate the un-certainty in geotechnical engineering. In this study, an attempt has been made here to apply the procedure for the estimation of uncertainty measurements based on the guidelines prescribed by National Accreditation Board for Testing and Calibration Laboratories (NABL) 141 (2016). The uncertainty of measurement was found out for geotechnical parameters such as specific gravity, liquid limit, plastic limit, shrinkage limit, standard compaction and shear strength for lateritic soil. The test was repeated five times to test for repeatability. The uncertainty of each of the parameters were calculated.

Keywords:

Paper ID 360

Estimation of Unconfined Compressive Strength of Cohesive Soils in and around Mysore, South India

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Unconfined compressive strength (UCS) of soils is considered as a significant soil parameter. The soil strength provides the benchmark for usage in any subsurface civil infrastructural constructions. The purpose of this research was to investigate the effect of soil type on the rheological parameters of a reengineered cohesive soil. According to the ASTM standard, the shear strength of the unconsolidated soils under unconfined circumstances is measured using Unconfined Compressive Strength (UCS) technique. Soil samples of Outer ring road, Mysore city were subjected to tests. The studies illustrate that, for sandy clay (SC), sandy – silt (SC – SM), silty sand (SM), and well-graded sandy silt soil (SW – SM), normal stress ranges from 1.693 kg / cm2 to 6.428 kg / cm2, whereas shear stress ranges from is 0.847 kg / cm2 to 2.384 kg / cm2 and internal angle of friction (α) ranges from 57° to 64°. The stress-strain diagram and Mohr circle exhibits average values of normal stress, shear stress and internal angle of friction for 4 major types of soil of the study area. The outcome of the experimental program led to govern the shear strength of the soil are also conferred.

Keywords: Geostructures, Unconfined Compressive Strength, Sensitivity of Soil, Stress-Strain Behavior, Mohr Circle, Rheological Properties

Paper ID 322

Analysis of Slope Stability for Hill Based Construction in NE India: A Case Study in Guwahati

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Guwahati, the gateway to North East India is surrounded by hilly terrain from three sides, which also constitutes the bulk of the city region. The hill soil consisting of stratified layers formed out of different degrees of weathering of the parent rock. Primarily two distinct types of soil formations are observed. A cohesive Reddish clayey soil layer forming the top layer of the slope formations mostly underlain by a less stable yellowish sandy soil layer building the core and bulk of the slope. The shear behaviour of this yellowish soil primarily governs the overall stability of a slope during any triggering event such as rainfall infiltration. The study analyses numerically the overall strength and shear behaviour of the hill slopes with varying slope inclination and its effects on slope geometry. Applying the Morgenstern–Price method of stability analysis, the stability comparison between slope geometries of undisturbed and remoulded soil has also been studied. The parametric study of undisturbed soil slopes signifies about 40% loss of stability with respect to 100% increase in slope angle at low moisture content. As the slope becomes more and steeper, the Factor of Safety decreases and also the variation of Factor of safety with respect to slope geometry gradually diminishes. At slope angle more than 70°, the slope becomes unstable owing to its height and shape only; hence saturation due to infiltration need not play a crucial role in instigating instability. For remoulded soil slopes the values of Factor of Safety and shear strength for all slope geometries and moisture content are significantly lower than their counterpart values of undisturbed ones with approximately 15% deficiency. It manifests for the presence of strong cementing properties in the original skeleton of the soil, which, once re-constituted, cannot be fabricated again. It implies the supremacy of models utilising the application of such properties of undisturbed soil which may be considerably significant for slope-based construction in the region.

Keywords: Slope geometry, Degree of saturation, Undisturbed, Factor of safety

Paper ID 304

3D Numerical Investigation of Stone Columns Simulated in Soft Soil

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Stone columns, which are known as a ground-improvement technique, are frequently employed by geotechnical engineers to strengthen the stability of foundations, reduce differential settlement, and raise the bearing capacity of soft soil. In the current research, numerical simulations utilizing Plaxis 3D, utilizing a FEM-based pro-gram, stone column behavior is examined. The behavior of the stone columns has been examined in relation to a number of characteristics, such as column spacing, diameter, length, and material attributes. The load bearing capability of the renovated ground has seen both qualitative and quantitative increases. The results showed that the stone column's ability to support loads had significantly improved.

Keywords: Plaxis 3D, Ground improvement, Stone column.

Paper ID 354

A Study on the Influence of Layout Configuration on Geotextile Reinforced Fill

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Geosynthetic-reinforced solution is a novel type of soil strengthening technique among other ground improvement techniques because of its cost-effectiveness, environmental advantages and ease of installation to improve load-bearing characteristics of weak subsoil. This study aims to investigate the improvement potential of using geotextile on a sandy soil bed. Different influencing parameters such as the top layer arrangement, spacing among consecutive layers, number of reinforcing layers and width of reinforcement have been investigated to examine layout arrangement's effect on load settlement characteristics. A steel plate of dimension 70mm × 70mm has been chosen to replicate model footing with a thickness of 16mm. A series of model plate load tests has been incorporated to examine the effects of layout arrangements on soil bed. Further numerical validation has been incorporated using PLAXIS 2D with experimental results. The study's findings demonstrate that reinforcement configuration has a high potential to improve the load-bearing characteristics of the geotextile-reinforced solution, where experimental results depicted a good agreement with numerical simulations. The configured reinforcement arrangements show an increasing trend of the load-bearing capacity of reinforced fill compare to the unreinforced condition, along with a substantial reduction of footing settlement. The incorporation of geotextiles in this research study is a commendable step towards ensuring environmental sustainability by stabilizing soil.

Keywords: Load-bearing characteristics, Geotextile, PLAXIS 2D.

Paper ID 392

Experimental and Numerical Investigation on Soil Reinforcement using a Sustainable Material, Jute Geotextile

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The existing soil at a particular site may not be suitable for construction activity due to poor bearing capacity and excessive compressibility. Natural jute geotextile fibres have recently been widely used for ground improvement because the material is environmentally friendly and abundant in Asian countries. In the present study, a laboratory experimental program through a triaxial test and a numerical analysis using PLAXIS 2D finite element model has been implemented to study the effect of jute geotextile on sub-grade soil modification. The experimental and numerical result shows that including jute geotextile on sub-grade soil significantly improves the soil strength by lowering the stress, strain, and displacement at the top of the sub-grade soil, increasing the shear strength and bearing capacity of the soil and by reducing the quantity of instant settlement. Therefore, by ensuring adequate long-term durability through suitable treatments already developed, jute geotextile may be considered an environmentally friendly, sustainable material for subgrade soil strengthening applications.

Keywords: Jute Geotextile (JG) Sheet, Triaxial Test, Finite Element (FE) Analysis, Soil Reinforcement, Bearing Capacity, Settlement.

Paper ID 414

Applications of Diaphragm Walls for Underground and Marine Structures – A Review

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A long-lasting reinforced concrete wall known as a diaphragm wall is constructed in the ground to support large-scale construction projects including dams, tunnel designs, deep basements, and enclosures. They function as a foundation, retaining wall, support for the underground construction, a way to pre-vent access to enable deep excavation. Diaphragm walls are frequently employed to hold back exceptionally deep excavations because they may be con-structed to resist extremely high structural stresses. They are suitable in urban areas with vast and older infrastructure, when it is important to reduce noise and vibration they are used. When dewatering is not an option and where the use of a typical earth retention system is prevented by geology and groundwater. Diaphragm walls are generally provided to support open berth structures in marine soils, it is used to solve construction of a deep foundation pit in large tunnel working shaft. It is advantageous compared to other retaining systems because of its large depth, small ground surface settlement, strong adaptability and it can combine the top-down method with traditional construction method to effectively control the deformation of ground buildings and underground structures close to the site. In the present study, a detailed review of case studies of application of diaphragm walls in marine conditions as well as for underground structures like metros is done. Also, in the present study, comparison of construction of diaphragm walls including behavior during berthing and seismic conditions is analyzed.

Keywords: diaphragm wall, berthing structure, metro construction, marine structures

Paper ID 415

Finite Element Analysis of Twin Tunnels in Granitic Rock

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Tunnels are risky and complex geotechnical structures. Long tunnels have been built with proper design ensuring proper stability, safety and have proved to be a boon to humans. Tunnels have been constructed successfully to pass the inter-state traffic and various other reasons. Use of underground space for tunnels leaves the land resource for other human activities. With the fast advancing world, globalization and urbanization has uplifted the life standard of people which has in turn led rapid consumption as well as deterioration of conventional resources. In the present paper, analysis of twin tunnels in granitic rock for Karwar-Kundapura highway is taken up. Rock found at the site is of variable strength which are classified based on RMR value. Midas GTX NX software is used to develop 3D model with parameters like terrain, rock properties and support system like umbrella reinforcement and rock bolts with shotcrete. The analysis is carried out for the tunnel at the time of construction and also post-construction to know various deformation on tunnel.

Keywords: Twin-tunnel, Granite, Deformation analysis, Umbrella system

Paper ID 429

Impact of Plastic Waste on the 3D Consolidation Characteristics of Sandy-Silt with Clay Soil

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Recycling plastic trash from water bottles has become a significant global concern since plastic garbage is one of the critical components of urban solid waste. The present study has taken the initiative to mitigate the harmful effect of plastic on the environment by performing a laboratory 3D consolidation test to investigate the impact of waste plastic fibres on the consolidation behavior of the soil. The experimental study used two different aspect ratios of 4 and 2 (length-to-width ratio) of raw plastic bottle fibres. Four plastic fibre percentages, such as 0.00, 0.20, 0.50, and 1.00 % by dry weight of the soil, have been chosen for the present study. The result shows that with the increase in plastic strip percentage, the compressibility of the soil decreases, and the coefficient of consolidation increases, thus reducing the soil settlement. The incorporation of plastic waste improves the soil consolidation characteristics; at the same time, it reduces the waste of plastic material from the environment, hence reducing environmental pollution.

Keywords: 3D Consolidation, Waste Plastic Fibres (WPF), Co-efficient of Consolidation (cv), Compressibility, Ground Settlement.

Paper ID 493

Evaluation of Geotechnical Properties of Pond Ash-Bentonite Mixture as a Potential Landfill Liner Material

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Landfill liners are crucial in preventing the migration of contaminants by blocking the flow of leachate. Although clay liners are commonly used because of their low permeability, they are susceptible to cracking and shrinking during unsaturated states, which can lead to leachate leakage. To address this, alternative materials with low permeability and shrinkage potential are needed. Treated pond ash, a by-product of coal combustion containing fine sand-sized spherical particles, shows potential as a landfill liner material. This study examines the geotechnical properties of pond ash-bentonite mixtures as potential liner materials. Mixtures with different bentonite percentages (0, 2, 4, 6, 8, 10, 12, 14, 16, & 18%) were tested using various geotechnical experiments such as liquid limit, plastic limit, unconfined compression, and consolidation tests. The results show that the addition of bentonite significantly increases the plasticity index and thus the water-holding capacity of pond ash. The unconfined compressive strength of this mixture increased by 64% with the addition of bentonite up to 8% and then it reduced with further bentonite addition. The consolidation tests showed that the permeability of raw pond ash decreased to less than 10−9 m/s with the addition of bentonite content, indicating that pond ash-bentonite mixtures have low permeability and can be suitable for use as landfill liner materials.

Keywords: Landfill, Pond Ash, Waste Utilization, Clay Liner, Laboratory Experiments.

Paper ID 494

A study on flexural fatigue performance of cement treated base in flexible pavements due to repetitive loading

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Flexible pavements are subjected to vehicular loads that can affect their performance and decrease the service life due to rutting and fatigue criteria. The flexible pavements constructed in India since the past several decades consisted of base layers with unbound aggregates. At present, India has witnessed massive growth in infrastructure construction activities both in rural and urban areas which has led to the scarcity of construction materials. In comparison to unbound granular layers, cement treated base (CTB) is a superior layer of the flexible pavement assembly that significantly reduces the stresses transferred to the sub-grade. Cement stabilised pavement bases provide a flexible response to rising traffic loads and frequency because they require little in the way of raw resources. This paper addresses methodology of designing cement treated base for flexible pavements. The fatigue performance of CTB beam specimens was assessed in the laboratory by repetitive loading under different stress ratios, and the findings were confirmed by comparing them to the fatigue model provided in the IRC-37:2018 guidelines for the design of flexible pavements. The research findings were utilised to assess how well the CTB performed in terms of fatigue under repeated wheel loads.
Keywords: cement treated base, fatigue testing, flexible pavements, repetitive loading.

Paper ID 523

2-D Analysis of Slope Stability Using Limit Equilibrium Analysis and Finite Element Analysis

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Slopes along the highway that too in hilly areas are more prone to landslides. Sometimes due to heavy traffic and also in monsoon seasons due to heavy rainfall the slope failure can occur. The slope failure can results in the damage to the mankind and the property. In order to overcome the slope failure, different slope stabilization techniques such as anchors, anti-slide piles, reinforcement, geotextiles, terracing, vegetation, soil nailing etc can be adopted. Therefore, slope stability analysis must be carried out for assessing the safety of slopes or embankments for the selection of suitable stabilization technique be-fore any construction. In the present study, the deterministic 2D slope stability analysis has been carried out for a specific slope in Agumbe ghat at Karnataka and another land-slide prone region in Dhobighat at Hyderabad. Both slope stability analysis has been performed using Limit Equilibrium Analysis (LEA) and Finite Element Analysis (FEA). Both slopes are found to be unsafe from LEA and FEA. Further, using anchors the slope has been stabilized and the Factor of safety in-creases in FEA and LEA. In addition to that parametric study has been carried out to determine the effect of the design parameters on 2D Slope stability anal-sis using LEA. It has been found that the slope at Dhobighat where mostly the well graded sand is available are more affected due to the change in the design parametyers as compared to Agumeb Ghat slope where the soil is mostly stiff clay. The study also concludes that for a specific slope FEA provide more conservative Factor of Safety (FOS) compare to LEA.
Keywords: Slope stability, FEA, LEA, Anchor

Paper ID 553

Characterization of Flexible Concrete Pavements using Demolition waste and Laterite

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In the present era of road construction industry, lot of scope is there with respect to alternate materials used for cement concrete roads. In the case of rural road construction, under Pradhan Mantri Gram Sadak Yojana (PMGSY) scheme, lot of scope is there for new initiatives for the replacement of natural aggregates. In this context, the present research work aims to replace the natural coarse aggregates using construction and demolition (C &D) waste. Also the project aims to replace the fine aggregates using Laterite. Hence, an attempt has been made to consider C&D waste and Laterite for the concrete work. Various test proportions were done to determine optimum percentage of replacement. Physical properties were obtained from the laboratory tests and correlated with the natural aggregate test results values. From the literature study, it is an evident that 30% to 40% of replacement can be done as coarse aggregate using C & D waste. Even in the case of major structural work, C & D waste can be used with significant results. In case of Laterite, literature study suggests 20% to 30% of replacement can be done effectively for fine aggregate. At an outset, the significant reduction in natural coarse/fine aggregates, results in both economic and financial benefit for the society. In this regard, combination of C & D waste and Laterite waste can be used effectively thereby producing eco-friendly or sustainable concrete roads for rural areas. Here the compression test and flexural test were conducted to analyze the strength parameters. Low volume roads/ Rural roads were usually of flexible or rigid pavements. In case of rigid pavements, provision should be there for thermal expansion and contraction. To avoid this issue, a new type of pavement is suggested as flexible concrete pavements. Here blocks will be made using waste plastic for desired shape. Concrete will be filled inside the plastic blocks. This type of pavement is also known as cell-filled pavement / block-filled pavement. Maintenance cost is less compared to normal concrete pavements. Hence these types of pavements are gaining importance in recent periods.

Keywords: Construction and demolition waste, Laterite, Rural Roads, Flexible concrete pavements.

Paper ID 674

Mechanical Strength of local soil enhanced by hybrid saw dust ash

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With the development of any nation depends upon the development of good infrastructure. In India due rapid infrastructural development need of good roads, generally, road subgrade and subbase layers are constructed using locally available soil it may not have desired strength, so its need to improvement to use as construction material, mostly through chemical treatment (as cost effective and sustainable method). This paper presents, the strength properties of local soil enhanced by mean of alkaline activated saw dust ash. The experimental investigation through compaction and unconfined compression test was carried out to understand the feasibility of effect of alkaline activated saw dust ash on local soil. The result showed that improvement in the strength properties and indicates that alkaline activated saw dust ash can be a good sustainable stabilizer. This may reduce the natural resource material and increases consume of industrial waste materials.

Keywords: Local Soil, Hybrid Saw Dust Ash, Sustainable Binder, Alkaline Activator

Paper ID 612

Behaviour of Piled Raft Foundation of Different pile lengths, Pile diameter and raft thickness for a High rise building by using Finite Element Modeling

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In this paper, the different variation of raft thickness, pile diameter and pile length on different case studies on two Pile configurations (PC). To studies the interaction behavior of changing the different-different parameters are used in this study. These various proportions to change with various parameters on pile length (LP), diameter of piles (DP) and raft thickness (TR) to improve the bearing capacity of the foundations. These components are improving bearing capacity of foundations. It is the major important role in the design of optimum selections of basic parameters in piled raft foundations are subjected to different loading conditions v/s settlement behaviors. This investigation to done the different collaborations of loading behaviors of on piled raft to shows the total and differential settlements of the buildings. Firstly, to calculate total loads on the buildings with the help of various Indian standard code (IS Code). To analyses the different behaviors of soil structure interaction based on their primary factors of LP, DP, and TR. Furthermore, to calculate these factors and loading conditions to choose an optimum selection of embedded parameters are based the finite element modelling (ELPLA Software). To also simulate the effects on load-settlement parameters are basically based on their distributions of shear force and bending moments is also investigated. The present studies to validate the PRF models v/s other models with various parameters and loading conditions to our best model for high rise buildings and compare the both results on the basis of their changing in the pile configurations P1 and P2. On the basis of the final and differential settlement in the pile configurations P1 and P2.

Keywords: Pile configuration · pile length · pile diameter · raft thickness · Numerical analysis · Settlement · finite element modeling

Traffic & Urban Planning

Paper ID 085

Waste Material-based Fillers for Patching Potholes Using Warm Mix Asphalt: A Study

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In India, the majority of the road network comprises flexible pavements constructed using the traditional Hot Mix technology. However, this technology has various drawbacks, including environmental concerns related to the emission of greenhouse gases and health hazards for construction labourers. To address these issues, the Warm Mix Asphalt (WMA) production method has been developed, with a lower production temperature than the traditional Hot Mix method. To evaluate the properties of materials used in WMA, laboratory experiments were conducted on aggregates and binders using standard marshal mix design methods. Based on these experiments, WMA was developed in the laboratory, and its stability characteristics were analyzed. To further improve the sustainability of WMA, this study focused on the evaluation of the performance of waste materials as fillers. The conventional stone dust was replaced with Rice Husk Ash, Waste Glass Powder, and Waste Brick Powder in different percentages (0%, 25%, 50%, 75%, and 100%). Marshal Stability tests were conducted, and it was found that the WMA with 25% of all the fillers (SD: RHA: WGP: WBP) showed a Marshal Stability 26.93% higher than that of conventional WMA. Therefore, this study recommends the use of 25% of Stone Dust along with RHA, WGP, and WBP with 25% each for patching potholes with sustainable Warm Mix Technology. Future research could focus on using different types of fillers to improve the sustainability of WMA further.

Keywords: Warm Mix Asphalt (WMA), Hot Mix Method, waste brick powder.

Paper ID 107

Impact Analysis of Modal Shift on Transport Ecological Footprint in Bengaluru

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Rapid urbanization and economic growth in Bengaluru city has resulted in highly congested road networks and hence nicknamed the “Choked City of India”. Improving the existing Mass Rapid Transit System (MRTS) is a sustainable solution to combat today’s rise in traffic congestion. Transport ecological footprint (TEF) is a tool that determines the impact of the urban infrastructure and transport modes on the environment. This study aims to understand the ecological footprint i.e., physical and energy footprints contributed by the transportation sector throughout the Bangalore Urban District(BUD). The analysis of data shows that the study area with a population of 1.36million generates about a 1.63million work/ educational trips per day having a prime modal split of 30% for buses, 10% for 4-wheelers(4W), 22% for 2-wheelers(2W), 3% by auto rickshaw, 28% by foot 5% by bicycle and other 2% by train. The physical footprint is estimated to be approximately 7408.8ha and the energy footprint of all four taluks comprising BUD is 1.095E+05ha. Therefore it is estimated that 9earths are required to sequester the emissions from transport. In view to reduce emissions, a scenario is proposed with a stated preference survey as Bus Transit, with urban and socio-economic attributes. A binary logit model developed using IBM SPSS software estimates that there is a 95% shift from 2W, 86.35% from auto, and 23% from 4W to bus transport. Thereby reducing the emissions rate by 44% and going down to 4earths to sequester the emissions from transport. The same scenario is forecasted for 2030 and 2050 and visualized spatially using QGIS software.

Keywords: Transport Ecological footprint (TEF), Physical footprint, Carbon footprint, Emission factors, Vehicle kilometer traveled (VKT)

Paper ID 125

Pedestrian Signal Violation and Its Impact on Vehicular Delay

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Pedestrian crossings have always been the most important road element as they provide a passage for the pedestrians to cross the vehicle stream. Variety of pedestrian crossings are available all around the world viz. zebra crossing, underground crossing, sky bridge crossing, signalized controlled pelican crossing, and intersection crossings. Their establishment is related with the available crossing rules, vehicle volume, funds, and the choice of authority. Problem arises when crossing facility is not selected adequately and when it is not used by the pedestrians as required. This paper presents research conducted to obtain the additional vehicular delay caused due to the signal rule violation by the pedestrians at a signalized crossing. Data is collected from two pelican crossing sites available at Chandigarh city of India. A model is formulated and validated comparing with already existing similar models for the pedestrian rule violation and delay occurred for the vehicular users at these sites are also compared with this model. It was found that the delay calculated using this model gives the values nearest to the actual conditions at site.

Keywords: Pedestrian, signalized crossing, vehicle delay, rule violation.

Paper ID 240

An Analysis of the Cost Associated with diversions caused by Metro Rail Construction Work.

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Metro rail development has gained considerable traction in a number of Indian cities. The success of Indian infrastructure development will have a major impact on the success of a metro project that requires substantial capital expenditures. Large number of metro projects have already completed, and some are in currently progress, and many more are expected to be completed in the future. As part of the preparation of the Detailed Project Report (DPR) for the different Metro projects, several benefits and costs are analyzed. During the construction of Pune Metro project, several diverted routes were designed. Costs associated with these diversions were not accounted for in the cost-benefit analysis. In this research paper author studies and analyzed the cost of diversion given during the construction of SNDT Metro Station. Observations were made at different locations within the study area utilizing the Moving Ob-server Method (MOM), mentioned in IRC-106. The diversion cost is deter-mined using the methods described in IRC SP 30 after data collection has been completed. The cost of diversion is calculated using both distance and time related Vehicle Operating Cost (VOC) for the period of 2016 to 2022. Authors found that this cost has an adverse impact on the cost-benefit analysis of the Pune Metro Project.

Keywords: Metro Rail Construction, Diversion Cost, Vehicle Operating Cost.

Paper ID 503

Sustainable Solid Waste Management System for The Ichamati Riverside Area of Pabna City

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Ichamoti River flows in Pabna city and has been transformed into a narrow canal due to indiscriminate occupancy and lack of proper maintenance. Except for the monsoon, water flows are reduced drastically during the dry sea-son. Presently, the river is mostly occupied by dumped waste and this waste has clogged the river by blocking the possibility of water flow. There needs excavation for removing the wastes from the river but also the importance of a sustain-able solid waste management system is a prerequisite for the proper management of Ichamoti River to ensure a robust river environment in the future. The objective of the study was to explore the present solid waste dumping scenarios along the Ichamoti riverbank of Pabna city and to propose a possible waste management plan which will be sustainable in the long run. The methodological frame-work consists of extensive field visits, Focus Group Discussions (FGD), and Key Informant Interviews (KII). A detailed Questionnaire Survey was also conducted to ensure stakeholder participation. The major issues in this area are inadequate waste management, disposal, and collection system, and a lack of awareness of the public regarding waste management. The 3R (Reduce, Reuse, Recycle) is a very excellent option as practiced by some poor families. To overcome the waste management issues this study found that low-cost regular waste collection sys-tems by the Pabna municipality from door to door and relocating the dumping station from the river bank to the appropriate location can make the solid waste management system sustainable.

Keywords: Ichamati River, Pabna City, Waste Dumping, Sustainable Solid Waste Management Plan.

Paper ID 571

Urban Resilience Assessment of Kandahar City, Afghanistan

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Due to the behavior of complex systems such as cities in the face of stress, strengthening resilience to mass displacement is becoming a more pressing concern. The concept of urban resilience is increasingly being used for the purpose of the ability of an urban system to anticipate, absorb and adapt to shocks and stresses and to respond in ways that preserve and restore its essential functions, structures, and identity. The main objective of this study is to assess the resilience of Kandahar City. The study utilized a mixed approach, consisting of both primary and secondary information obtained through surveyed questionnaires with households and interviews with stakeholders in the study field. After that, resilience to disasters was assessed through UNDISR framework with specific scores from zero to three chosen for each of the different aspects. The results show that Kandahar City is not highly resilient to disasters such as flooding and drought. Some aspects such as poor urban governance, lack of institutional capacity, and financial capacity are the weakest and most concerned areas. On the other hand, urban issues identified are highly critical and have a significant impact on the performance of urban resilience. Lack of awareness, low income of people, and poor condition of infrastructures are strongly associated with vulnerability to natural hazards. Thus, the study proposed strategies covering different aspects of low resilience and the current condition that would potentially enhance urban resilience. The research findings can be used by planners and policymakers as well as other cities having similar characteristics. In addition, the study could be taken as a source to start assessing urban resilience and developing associated enhancing measures.

Keywords: Sustainability; Households; Resilience; Strategies; Urban Issues

Paper ID 679

Analysis of traffic data at Uncontrolled junction and recommending suitable remedies for the junction – A case study at Veera Savarkar flyover Junction-Yelahanka new town, Bengaluru

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An evaluation of the traffic flow situation at a chosen road intersection to determine the safety of vehicle maneuvers and the urgent need for a control device to monitor and control the traffic flow at the study location. The Study objective of this study is to highlight shortcomings in prior research and recommend a solution to the conflicts that arise at uncontrolled intersections with mixed traffic flows in densely populated Indian cities like Bengaluru (study area: Yelahanka region). The data was collected based on traffic flow conditions like road inventory survey, volume count and spot-speed analysis for each direction at selected intersection. Finding the suitable remedial measure by checking out the existing traffic conditions and road condition using result analysis of traffic data. Thus, to provide safety measures for traffic maneuvers need to evaluate the intersection and introduce control devices such as signals, markings, signs. The traffic safety analysis was done by gathering traffic data and analysed using accepted techniques.

Keywords: Uncontrolled intersection, traffic flow, maneuvers, evaluate

GIS & Remote Sensing

Paper ID 016

GIS-Based Assessment of Groundwater Quality and Suitability for Drinking Purposes in Smart City Bhubaneswar, Odisha, India

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Groundwater is one of the main source of water for drinking purpose in smart city Bhubaneswar, Odisha, India. A geochemistry study of groundwater was conducted for the full year 2020.The aim of this study was to find out the quality of ground water for drinking purposes. Prior to and during the monsoon season , samples from nine municipal bore wells were taken and their water was then examined for physico-chemical parameters such as pH, EC, TDS, TH, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, CO_2^{-3}, HCO^{-3}, Fe, Cl^{-}, SO_4^{2-}, NO_3^{2-}, and F in accordance with APHA standards (1985). Arc GIS has been used to prepare geographic information system based spatial distribution maps of different major elements. Next, the groundwater in the research region is evaluated using the water quality index (WQI) to determine if it is suitable for human consumption. The groundwater in the research area of the smart city region of Bhubaneswar (BMC) had a WQI that indicated it was generally suitable for drinking. With reference to BIS 10500: 2012 for Drinking Water, almost all of the parameters are found to be below the allowed limits, with the exception of Iron (Fe). TDS, TH, EC, and chloride are all shown to be strongly correlated with one another. It is clear from the data shown in the Hill-Piper diagram that the groundwater in the region of study does meet the "Indian Standard (IS)-10500:2012" for potable water.

Keywords: Groundwater Quality, Water Quality Index (WQI), Spatial Distribution, Remote Sensing & Geographical Information System (GIS), Correlation, Hill-Piper Diagram.

Paper ID 160

Reservoir Induced Spatio-Temporal Changes on Submergence on City Growth and Land Use Pattern Change in Bagalkot District Using Remote Sensing and GIS

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Bagalkot and surrounding several villages have come under submergence due to upper Krishna project and Alamatti Dam. A new area (Navanagar) was identified for rehabilitation, of affected people. But in spite of new area for rehabilitation, the people found to stay in old places and some purchased new plots in some other areas and started dwelling. This has resulted to several satellite villages around Bagalkot city. Due to uncertainty associated with its growth, several small towns around Bagalkot are growing faster whereas Bagalkot growth has become stagnant. Overall, it is of interest to study the growth pattern and fate of a city under submergence and its effects on it and surrounding areas. The Bagalkot district is known for its World heritage sites, historical monuments and architectural marvels, which may be at risk due to changed climate and urban spawn. It is planned to assess the risk of historical places in the area also. The effect of taking up a large project like upper Krishna will always be on water bodies and land use and climate and environment in the area. These factors will also be addressed.The literature has been analyzed to better understand the major issues and challenges in the land use detection.

Keywords: LULC, LRI, RS & GIS, Sustainable Planning

Paper ID 175

Assessment of Soil Salinity in The East Upputeru Catchment of Andhra Pradesh Using Geospatial Techniques

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Inland brackish aquaculture ponds are becoming more and more saline, hindering agriculture growth and impacting food security in many locations of Asia. Several factors, including climate change, rising seawater levels and their mineralization, complex collector-drainage systems, and insufficient adherence to agrotechnical requirements, are causing the expansion of salt-affected regions. These factors, in turn, cause a substantial decline in crop yields and the abandonment of cultivated land for agricultural use`Based on the findings of a field survey and laboratory investigations, soil salinity maps of the study area were produced to investigate the dynamic changes in soil salinity. These maps used the empirical Bayesian kriging (EBK) and inverse distance weighting (IDW) interpolation techniques. The geospatial interpolation findings demonstrated the EBK method's high potential and accuracy for mapping longitudinal changes in irrigated regions affected by salt. In addition, the study found that intensive aquaculture has a strong relationship with soil salinity, while geographical features have a weak relationship. Based on these findings, agricultural experts and local farmers are strongly urged to take the following actions to improve the actual salinity of the soil state in the province's irrigated areas: strategically and economically use surface water, monitor drainage networks to ensure maximum capacity, and quickly integrate traditional methods with cutting-edge GIS technologies.

Keywords: salinity intrusion, aquaculture, kriging, geospatial interpolation

Paper ID 249

GIS Applications and Machine Learning Approaches in Civil Engineering

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The positions of earth observations or features, along with the properties that go with them and the spatial relationships that exist between them, are displayed using GIS (Geographic Information Systems) data. There are many different types of GIS data analysis, some of which could involve model-ling and projections that require a lot of processing power and challenging, particularly when big datasets are involved. Because of its relative speed, accuracy, automation, and repeatability, techniques like machine learning (ML) are being suggested as a potential game changer. Possessing the capacity to transfer results from one database to another is may-be the biggest advantage of using both GIS and ML. Deep learning (DL) techniques have grown in prominence over the past several years and are now the new standard for data processing in remote sensing analysis. In the fields of medicine, urban planning, and environmental modelling like landslip susceptibility prediction (LSP), GIS and ML technologies have been employed extensively. This study provides an overview of the most recent ML techniques that have been used to analyse geographical data for Infrastructure/Urban Development, Health, Flood Prediction, Groundwater Detection and Contamination, Erosion Modeling and Prediction, Landslide Susceptibility Pre-diction (LSP), LULCC modelling, Managing Forests and Their Resources, and Biodiversity Conservation, and health using GIS tools.

Keywords: Machine Learning, Urban development, Geographic Information Systems.

Paper ID 259

Unlocking the Potential of Drone-Based Survey and Mapping for GIS Enabled Infrastructure Management

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The use of drone survey and mapping has gained significant attention in recent years, particularly in the domain of infrastructure management. The SVAMITVA Scheme, which uses drone technology to survey and map rural inhabited lands, facilitating the issuance of legal ownership cards and promoting rural development. This paper demonstrates a detailed comparison between orthomosaic images (ORI) generated using Pix4D against satellite map or image. The drone-based survey of Penumuru village offers an exceptionally detailed representation, facilitating detailed analysis and supporting diverse applications that demand accurate and comprehensive visual data. It highlights the transformative potential of drone-based survey and mapping, offering cost effective, accurate, and timely data for decision-making and enabling the development of sustainable and efficient infrastructure.

Keywords: GIS, Drone Survey, ORI Maps, Pix4D, Sustainable Technology, Infrastructure management

Paper ID 611

Drainage morphometric analysis of a Challakere watershed using Remote Sensing and Geographical information system

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The morphometric study of a basin in the context of morphological and hydrological parameters has been emphasized with the aid of Geomatic tools. The conjugate of geological, geomorphological, hydrological, and fluvial parameters is analyzed to obtain the relationship between linear, relief, and aerial aspects of the Challakere watershed in Chitradurga district, South India. The drainage morphometric parameter is evaluated by DEM data in ArcGIS 10.3 version. The river Vedavathi and its tributaries flow on an undulated hard rock terrain comprising a chain of parallel mountains and narrow valleys. In the Current study, drainage morphometric evaluation is carried out to a 4th order stream of the Vedavathi river of Challakere basin, its average elevation is 500m MSL, and the drainage area of the basin is 1830km2 (Table. 1). Basin Exhibits sub dendritic to dendritic drainage patterns. The stream order of the basin is exclusively driven by the influence of physiographic and lithology of the area. From the result, the basin comprises an irregularly increasing stream order, whereas the fifth order consists of 164 drainage networks, and the overall length of the stream is 701km.

Keywords: Morphometric analysis, Drainage, Stream order, Fluvial, DEM

Paper ID 650

Performance analysis of fixed and seismic base isolation system for multi-story building

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This paper focuses on the implementation and effectiveness of a base isolation system for reinforced concrete structures during seismic events. The study presents a 3-D reinforced concrete frame building with rubber bearings as a case study, using SAP 2000 software for modeling and analysis. Seismic load calculations are performed according to IS 1893-2016 to meet earthquake-resistant criteria. This study examines a 3-D reinforced concrete frame structure with dimensions of 21m on the x-axis and 21m on the y-axis, comprising a G+6 configuration with a height of 24m.The objective is to increase the natural time period, reduce storey drift, and lower the acceleration response of seismic events. The paper evaluates the effectiveness of the base isolation system in terms of maximum shear force, maximum bending moment, base shear, storey drift, and storey relocation reductions. Furthermore, the paper discusses the generation of the flooring spectrum or response spectrum by analyzing the structure through time history analysis. The findings highlight the potential benefits of base isolation systems in mitigating the detrimental effects of seismic events on buildings.

Keywords: Sap 2000; Base isolation; Rubber bearing; Time history analysis.

Irrigation & Water Resources Engineering

Paper ID 046

Evaluating the suitability of groundwater for irrigational purposes Using Electrical Resistivity Technique and the implementation of Artificial Recharge at Kalugotla (V), Veldurthy (M),Kurnool District, Andhra Pradesh

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The rapid degradation of natural resources in chronically drought-prone areas is alarming, mainly due to increased biotic pressure on the fragile ecosystem, inappropriate management, and conservation practices. In the study area, hydrological boundaries serve as the unit of development, and all households are interconnected, not only in improving individually owned resources but also in developing and managing common resources like grazing lands, tree cover, and groundwater. The authors identified the rural area of Kalugotla (V) to be located in the south of Kurnool town. Since the total number of bore wells is estimated to be around 154, the density of wells indicates that part of the area is over-exploiting groundwater, especially along the stream course. An average area of 1294 acres of land has been irrigated under the bore wells at an average rate of 8.40 acres per well. The discharge of bore wells varies from 1400–4500 LPH. Based on field investigations, it is concluded that further drilling is not advisable to maintain groundwater balance.

Keywords: Groundwater, Aquifers, Bore wells, well inventory, Electrical Resistivity Method

Paper ID 186

Assessment of Drought Vulnerability Using Meteorological Drought Index in Shimsha Basin

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One of the major threats to sustainable development is drought. India is an agriculture predominant country and most of its agricultural land is rain-fed. After Rajasthan, Karnataka has the second largest geographical area which is prone to meteorological drought. For sustainable development, drought assessment is the first step in developing drought mitigation measures. Drought indices are used to assess drought, and research has shown that while certain dryness indices are better than others at describing drought, all drought indices are locally evolved. In this research the Shimsha basin is assessed for drought vulnerability using a meteorological drought index called percentage departure (PD). As the study area has a larger portion of agricultural land, it is very crucial to understand the drought characteristics to plan the agricultural activities. For this analysis, monthly rainfall data for 30 years from nine stations of IMD gridded data is used from 1989-2018. The study revealed that the study area is receiving decent amounts of rainfall across all the stations. And the results reflect no drought condition in most of the years across all stations and followed by mild drought, moderate and severe drought conditions.

Keywords: Drought vulnerability, Meteorological drought, Percentage of departure, Rainfall pattern.

Paper ID 188

Towards Selection and Improving the Performance of the SWAT hydrological model: A Review

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In watershed hydrology, it is challenging to physically monitor various aspect that influences the hydrological processes. To quantify these watershed processes in a basin with changing spatial and temporal characteristics, public domain hydrological models incorporating inverse modeling are considered. But the first confusion that arises in modeling these processes is which hydrological model should be considered and what methods should be adopted to quantify the best hydrological parameters. Even though a best model is considered hydrologists assumption of parameter insensitivity and uniqueness over varying climatic condition and space, the conditionality of model calibration with unique technique and performance indicator prone to the poor performance of the model. Betterment of model performance can be achieved by switching parameters sensitive to varying climatic conditions and reprieving the conditionality of model calibration. Hence, the purpose of this paper is to review (i) different hydrological models available around the globe, (ii) the selection criteria for the hydrological model and the superiority of the SWAT model, (iii) the description of the SWAT model, followed by sensitivity analysis and calibration techniques involved in SWAT output (iv) assess the benefits of employing the SWAT model and its applications and (v) summaries of season-based SWAT evaluation.

Keywords: Hydrological model, SWAT, Sensitivity analysis, calibration, Un-certainty analysis, season-based evaluation.

Paper ID 221

Computational Investigation of Energy Dissipation Using Rigid Stepped Spillway

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Spillways are the hydraulic structures used to destroy the surplus kinetic energy of floodwater downstream of the dam, having applications in flood mitigation, river engineering, soil and water conservation. It is a concern over the past years that flood damages the dam structure due to overtopping, so it is important to reduce the impact of flooding over the structure by providing a safe passage of water. Steps provided over spillways improve the efficiency of energy dissipation from rapidly varied Cascades. In this research paper numerical simulation of flow over a rigid stepped spillway is performed using the CFD technique using the k-Ɛ turbulence model with the Volume of Fluid (VOF) method to resolve the dynamics of free surface flow. Three models having three steps with fixed spillway heights of 30 cm and varied step dimensions (10cm, 15cm, 20 cm) of spillway were tested for flow characteristics. Five different discharges per unit width ranging from 0.020 to 0.95 m2 /sec were passed over each model. The conclusion from the result is that energy dissipation increases with an increase in step width and decreases with an increase in flow rate. The present study is in good agreement with the past studies.

Keywords: Computational Fluid dynamics, Energy dissipation, Stepped Spillway, Volume of fluid, flow rate etc.

Paper ID 346

Smart Watering: Revolutionizing Irrigation with AR and IoT

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India is the country of villages and agriculture plays a vital role for development of the country. In Irrigation system, depending on soil type, water is provided to the plants. In agriculture, it is very important to get information about the fertility of soil and then to measure the moisture level of the soil. In this, Automated Drip Irrigation system, Internet of Things (IoT) and Augmented Reality (AR) technology is used. Arduino Uno, Moisture Sensor and other electronic tools are used to supply an adequate amount of water need-ed by plant. This irrigation systems can help in water-resource utilization can be optimized in farming landscape. Augmented Reality in Unity prototype is provided to visualize the model. The integration of AR technology into automated drip irrigation system has the potential to bring significant improvement to the agriculture industry. In this application, watering of plants is automated using moisture sensor, based on the readings of sensor. This application saves the manpower and is time efficient. The system is fully operational, and the outcomes of the predictions are highly positive.

Keywords: IoT, AR, Drip Irrigation, Arduino Uno, Moisture Sensor.

Paper ID 351

Smart Water Management: Using Machine Learning to Analyze Water Quality Index

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The availability of clean water is essential for public health and various industrial processes. However, sustaining the water quality is a challenge, because of the ever-increasing demand for water and the effect of human activities on water resources. Because of this, water quality prediction using the machine learning techniques is an emerging field of research that helps in forecasting water quality accurately. In this paper, a machine learning-based technique is proposed to predict quality of the water, using historical water quality data. Based on water quality index, usage of the water is being classified into three distinct categories, namely, Drinking, Agriculture, and Industrial. Then performance of the model is evaluated for optimization using Linear Regression Model, Random Forest, Decision Tree Model and XG-Boost regression to enhance the accuracy of the model. In order to assess the water quality, parameters such as PH, Dissolved Oxygen(DO), Biochemical Oxygen Demand(BOD), Nitrate, Coliform and temperature, the quality of water can be determined, and future water quality can be predicted [17]. It helps in monitoring and managing the quality of water in real-time, identifying potential risks, and developing strategies to mitigate them. This experimental result proves that the proposed approach achieves high accuracy in predicting water quality and can be used as a reliable tool for water quality management. Water quality prediction using machine learning has the potential to improve the accuracy and efficiency of water resource management, leading to better environmental and public health outcomes.

Keywords: Water Quality, Machine Learning, Classification.

Paper ID 526

Spatio-temporal trend of monthly and annual rainfall in Mahi lower River basin, Gujarat, India

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Climatic variability particularly rainfall has received a greater attention throughout the world. India is an agricultural country, and it is very important to assess the impact of changing climate on monthly and annual rainfall, to identify the necessary changes required in the cropping practices. In the present study, the trend analysis in rainfall in Mahi lower River basin, Gujarat, India is carried out based on annual and monthly rainfall data. The impact of changing climate on rainfall has been assessed using the data available from State Data Centre from 1990-2020. The Mann-Kendall non-parametric statistical test, Sen's slope estimator, linear regression analysis has been applied for rainfall trend detection. Inverse distance weighting (IDW) method has been representing the trend spatially. Spatial distribution of the trend of the rainfall has been represented on monthly and annual time scale. It is found that Z – Statistics and Sen's slope indicated that the month of August results into significant increasing trend, while the month of June shows negative trend in almost entire study area. July, September and October showed non-significant increasing trend. The above analysis indicated that monsoon season tends to start late. The results will be helpful for cropping practices adapted in the study area.

Keywords: climate change, Mann-Kendall test, Sen's slope estimator, linear regression analysis

Paper ID 576

Development of Low Cost Fiber Reinforced Concrete Sluice Gate to Mitigate Floods in Small Dams

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This paper presents the development of Fiber Reinforced Concrete (FRC) using carbon fibers for the application of sluice gates in small dams. This study aims to investigate the mechanical properties of the developed FRC and compare them with the properties of conventional concrete. Carbon fibers were chosen as the reinforcing material due to their high strength, low weight, and corrosion resistance and as a sustainable alternative to traditional reinforcement materials like steel fibers. The methodology involves the use of carbon fibers as a reinforcement material for concrete mixtures. A series of concrete samples were prepared with varying percentages of carbon fibers, and their mechanical properties were evaluated through standard testing procedures. The results showed that the developed FRC having 0.5% fiber had superior mechanical properties compared to conventional concrete. The compressive strength of FRC for 28 days is 64.761 N/mm2 whereas that of the conventional concrete is 41.640 N/mm2. The tensile strength of the FRC is 3.40 MPa whereas that of the conventional concrete is 2.303 MPa, the findings of this study demonstrate the potential of using carbon fibers in FRC for the application of sluice gates in small dams. The implementation of automation in the operation of the sluice gate at various conditions has been done.

Keywords: Fiber reinforced concrete, carbon fiber, Sluice gate, small dams, corrosion resistance.

Paper ID 605

Groundwater potential zones of Kunigal Taluk, Tumkur District, Karnataka state, India, by GIS Techniques

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The groundwater sources is investigated in Kunigal Taluk and represented in this paper. To do so, the research area's prospective groundwater zones were located using remote sensing and a Geographic Information System. To produce the groundwater potential zones, many maps (e.g., base, hydrogeomorphological, geology, drainage, slope, land use/land cover, lineaments, and soil map) are employed in Kunigal Taluk, groundwater has a key role in changing consumption patterns as well as unequal rainfall. The precise information Geology, slope, drainage density, geomorphic units, and lineament density are all considered when determining the groundwater potential zone using Remote Sensing and GIS. In Arc GIS version 9.2, it is then combined with a weighted overlay. For each of these parameters, appropriate ranks have been assigned in the analysis found that area 208.51sqkm found excellent water potential and 55.09sqkm poor water potential, overall 21% water potential available out of 981.55sqkm.

Keywords: Groundwater potential zones, lineament zones, geomorphology, slope.

Paper ID 669

Numerical Modeling Investigations of Hydraulic Jump Characteristics over a Chute Spillway

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A Chute spillway is a hydraulic structure designed to convey water from a higher level to a lower level with a steep slope, typically used in dam structures. The flow enters through the inlet at a higher level and passes down the lined channel to the outlet at the floor level. As water flows down the chute spillway, it gains kinetic energy attaining super critical velocity creating a hydraulic jump at the foot of the chute. In this study, the hydraulic jump forming in the chute spillway with an expanding stilling basin, chute blocks, floor blocks and end sill is simulated using SST K-omega turbulence model. The characteristics and energy dissipation of hydraulic jump are investigated by means of simulations using the finite element method. The free surface of the flow was determined by the volume of fluid method. The effects of different mesh sizes were compared. The velocities and subsequent depths were obtained.

Keywords: chute spillway, expanding stilling basin, hydraulic jump, SST K- Omega model.

Climate Change & Net Zero Targets

Paper ID 079

An experimental study on Optimal evaluation and Operational conditions of Thermal Energy storage systems in Green Building

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Currently, the building industry is focusing on the requirement for high energy utilization. It is critical to optimize energy use by utilizing renewable re-sources. The use of phase change materials in thermal energy storage systems is gaining popularity in passive applications for green buildings due to their innovative approach. The proposed work focuses on the incorporation of MWCNT additive Sodium poly acrylate as PCM materials into the walls, panels, and roofs of passive structures, as well as the assessment of optimal energy consumption in green buildings via indoor environmental quality (IEQ). A novel framework was developed using the response surface method and the hill climbing technique to identify the most efficient use of energy output, charging time, and heat transfer rate based on the input phase such as input air condition temperature (25-28°C), air conditioner flow rate (100-600 cfm), and relative humidity (35-55%). According to the results, the optimal energy transfer rate of the PCM wall was found to be 53.86 during a charging duration of 39 minutes. The amount of thermal energy stored by the PCM wall to maintain the room temperature of 26 degrees Celsius was discovered to be 15,400 kJ. This energy is adequate to keep the room temperature stable for three days.

Keywords: Green building, renewable energy, indoor environmental quality

Paper ID 112

Green Manufacturing and Evaluation of Concrete with Improved Mechanical and Thermal Properties using OPC Grade 43 and Fly Ash

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This paper investigates the effect of fly ash on the mechanical and thermal properties of concrete in order to address energy conservation and reduce carbon emissions in the building industry. The study shows that conductive heat transfer is responsible for energy consumption and carbon emissions in buildings. The conductive behaviour of concrete is modified by using fly ash. The study finds that the inclusion of fly ash in the mass of cement significantly improves the compressive strength, toughness and also increases its durability. Fly ash can be used to partially replace cement and reduce the greenhouse effect, depending on the type of cement used. The paper presents the results of an experiment in which the compressive strength and thermal conductivity of concrete containing different percentages of fly ash were tested. The mix proportion was designed as per IS: 10262-2009/IS: 456-2000 for M25 with OPC replacement by fly ash in percentages of 0, 15, 25, and 35. The study finds that the compressive strength of concrete increases up to 15% of fly ash, compared to conventional concrete strength whereas the thermal conductivity of concrete increases by the use of fly ash. The study concludes that the use of 15 % fly ash sin M25 concrete can improve its mechanical and thermal properties, making it a more sustainable building material that can help in addressing the issue of energy conservation and reducing carbon emissions thus have significant implications for the building industry in terms of reducing its carbon footprint.

Keywords: Green Manufacturing, Concrete, Fly Ash, Mechanical Properties, Thermal Properties, Compressive Strength, Sustainability.

Paper ID 138

Spatiotemporal Variability of Short-term Meteorological Drought for Semi-Arid North Gujarat Region, India

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Present research analyzed spatial and temporal variability of short-term meteorological drought using Standardized Precipitation Index (SPI) and non-parametric trend tests for semi-arid north Gujarat region, India. The SPI-6 indicating meteorological drought caused from seasonal rainfall patterns have been thoroughly examined considering drought characteristics such as intensity, du-ration, recurrence probability and major historical drought years. The SPI-6 analysis along with non-parametric trend tests such as Mann-Kendall (MK) and Modified Mann-Kendall (MMK) for trend significance, Sen's slope (SEN) and Linear Regression (LR) for trend magnitude and Lanzante's test (LNZ) for change point detection were performed on Indian Meteorological Department (IMD) gridded rainfall data at 0.25° resolution having time span 1951-2020 years. The analysis revealed major drought events happened in the years 1968, 1974, 1987, 1999, 2002 and recently in 2018 which were spatially distributed for the entire region using IDW interpolation method in GIS-Environment. Based on the average SPI-6 values over the entire region, 1985-1987 and 1999-2002 time periods were observed to be severely dry spells in which 1987 was the extreme drought with intensity up to -4.24 in southern parts. The trend analysis of SPI-6 values highlighted negative trends in about 17% of the grid points indicating drought prone area where-as about 83% of the grid points revealed positive trends indicated increasing wet spells. Present research outcomes will be helpful in crafting regional drought policies for the sustainable management of water resources in changing climate.

Keywords: Meteorological drought, Standardized Precipitation Index, Climate change, Rainfall, Trend analysis

Paper ID 433

Green Steel: A Sustainable Solution for Low Carbon Building Construction

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The increasing demand for greener approaches has made it critical for the industry to seize the opportunity, adopt new ways of thinking and set standards for the transition to a greener future. As the world strives to reduce greenhouse gas emissions, construction companies are playing an even bigger role. Green buildings have an opportunity to tap demand beyond geography and architecture. In fact, greener business models can attract sustainable investments. But by 2030, we can reduce fixed carbon in commercial buildings by 70%. In building construction, the use of green steel can help reduce the carbon footprint of buildings and contribute to the goal of achieving sustainable and environmentally friendly structures. Green steel also offers economic benefits such as reduced production costs and increased energy efficiency. With increasing demand for sustainable building materials, the use of green steel is expected to increase, creating new opportunities for the steel industry and promoting a more sustainable future for the building construction sector. Green steel also offers economic benefits such as reduced production costs and increased energy efficiency. With increasing demand for sustainable building materials, the use of green steel is expected to increase, creating new opportunities for the steel industry and promoting a more sustainable future for the building construction sector. This article details the benefits of green steel for manufacturing, structural support, its role in reducing carbon footprints, and environmental protection opportunities.

Keywords: Green Steel, Carbon Footprint, Sustainability

Paper ID 675

Monitoring Climate Hazards, Rice Production Risks and Management Practices in Bharathapuzha River Basin (BRB), Palakkad, Kerala

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Climate risk management in agriculture is a critical concern for sustainable pro-duction and livelihood. This research is an attempt to monitor climate hazards with respect to rainfall variability and its patterns in Bharathapuzha basin (BPB), Palakkad, the rice bowl of Kerala. It was noted that there are no research works published on the recent rainfall trends in this basin. Where there are fewer monitoring stations, satellite remote sensing provides better picture of rainfall distribution of a region. Climate Hazard Group Infrared Precipitation with Station Data (CHIRPS) is one of the latest high-resolution quasi-global satellite-based rainfall datasets used for rainfall measurements. CHIRPS data is used for getting an overall rainfall distribution in the basin from 1989 to 2020. Results shows that CHIRPS has captured the spatial pat-tern and seasonality of monsoon, the eastern side of the basin is comparatively dry with 700 mm of annual rainfall and west portion of the basin gets 2600 mm of annual rainfall. Precipitation Concentration Index (PCI) is used to evaluate seasonal precipitation changes and heterogeneity of monthly rainfall within the basin. PCI value is less than 10 in winter hence the precipitation is uniformly distributed throughout the basin however, PCI is over 40 in July, June and October months representing a significant irregular rainfall distribution throughout the basin. Through this research, weather early warning is distributed to the rice farmers and the initial survey revealed that dissemination has helped the rice farmers to a great extent for risk reduction. Small and marginal rice farmers had an opinion that extreme rainfall events such as floods and droughts is posing havoc in rice production in the recent past. The drought in the year, 2016 and floods of 2018, 2019 and 2021 created destruction to human life and crop production, traditional varieties are reported to be more resilient to hazards. Adopting a combination of technology solutions such as ICT based weather early warning and nature-based solutions aid to lessen carbon foot prints and severe negative impacts. Spatio temporal rainfall variability analysis support not only farm-ers or agriculturists, but hydrologists, geologists, engineers working on surface or groundwater irrigation, and policymakers to manage available water resources efficiently.

Keywords: Rainfall, CHIRPS, DRR, Bharathapuzha basin (BPB), Precipitation Con-centration Index. Sustainable Agriculture, Rice farming

Natural Hazards

Paper ID 342

Enhancing Flood Forecasting Accuracy through Machine Learning Approaches

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Flood prediction is a critical aspect of disaster management and requires accurate forecasting techniques to mitigate the potential risks and impacts. In this study, a flood prediction model is developed, based on machine learning algorithms. The objective is to develop a robust and reliable system that can forecast the occurrence and severity of floods in a specific region. The proposed model utilizes historical data on rainfall (in millimetres) to train the machine learning algorithms, such as decision tree, K-nearest neighbours (KNN), random forest, and logistic regression algorithms to build predictive models. These algorithms are known for their capability to handle diverse data patterns and provide accurate predictions. The dataset used for training and evaluation is sourced from the region of Kerala, India, which experiences frequent flood occurrences. The data is pre-processed, including cleaning, handling missing values, and converting categorical variables, to ensure the quality and compatibility of input features. Experimental results demonstrate the effectiveness of the developed models in flood prediction. The decision tree algorithm provides interpretability and identifies significant variables influencing flood occurrence. The KNN algorithm shows promising results in capturing local patterns and neighbours' influence. Random forest lever-ages ensemble learning to enhance prediction accuracy, while logistic regression estimates the probability of flood events. The proposed flood prediction models offer valuable insights for early warning systems, disaster response planning, and resource al-location. The integration of machine learning algorithms enhances the accuracy and reliability of flood prediction, facilitating proactive measures to mitigate the potential risks associated with flooding.

Keywords: Machine Learning, accuracy, Recall, Receiver Operating Characteristics, Decision Tree, Logistic Regression, Random Forest and KNN.

Paper ID 411

Landslide Vulnerability in The Sangu-Matamuhuri River Basin of Southeast Bangladesh

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The vulnerability to landslides is becoming a more prevalent concern given their escalating occurrence and the rising climatic and man-made impacts fostering the frequency. The Chittagong Hill Tracts experienced several landslides in recent years. Considering the river basin in the hill tract area with lots of small runoff channels, the proper comprehension of the landslide vulnerability is essential for sustainable integrated water resources management. The methodological framework comprises two stages: firstly, to identify the landslide-prone areas in the basin by overlaying six factors, rainfall, elevation, slope, soil characteristics (lithology), land use and land cover (LULC), and historical land-slide events, each of which has been weighted using the pairwise matrix of the analytical hierarchy process (AHP). Secondly, to explore the factors that accelerate vulnerability in the basin to understand the associated drivers and to provide recommendations. The reason for the landslides varies from season to season. Along with the climate-extreme rainfall events, the recent development works with unplanned hill-cutting, and deforestation are adding vulnerability in the basin. The outcome of the study, landslide vulnerability zoning, and factor identification will aid policymakers in making informed decisions for sustainable and integrated water-shed management.

Keywords: Chittagong Hill Tracts, Sangu, Matamuhuri, River Basin Management, Land-slide, Vulnerability Assessment.

Paper ID 451

Comparative Analysis of Machine Learning Models for Earthquake Prediction using Large Textual Datasets

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Earthquake prediction is essential for mitigating risks and minimizing damages caused by seismic events. This research paper presents a comparative analysis of machine learning models for earthquake prediction using a large textual dataset. The dataset encompasses comprehensive details of past earthquakes and serves as the foundation for training and evaluating various models. Four regression models, including linear regression, decision tree regression, random forest regression, and a deep learning architecture, are employed to capture different aspects of earthquake patterns. The linear regression model provides a simple baseline, while decision tree and random forest regressors capture non-linear relationships and ensemble learning. The deep learning architecture leverages the dataset's complexity to capture intricate patterns. Extensive experimentation and evaluation are conducted to assess the models' performance using appropriate metrics. The findings offer insights into the strengths and weaknesses of each model in earthquake prediction, facilitating informed decisions for future earthquake forecasting endeavours.

Keywords: Earthquake, Magnitude, Machine Learning, Regression

Others

Paper ID 051

Exploring Walkable Localities as Organizing Principle of City Plan

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Citizens aspire for good quality spaces and availability of amenities close to their homes in the neighborhood. They are thus encouraged to walk to the marketplaces, parks, and other places of daily visit, which keeps them healthy. This paradigm shift of walkable localities in the planning of the cities as a global approach, calls for an investigation of whether there is adequacy in terms of amenities and whether they are within the walkable distance from homes. In this context, the "15- minute city" as defined by Carlos Moreno was an ideal urban area where most human needs and aspirations were located within a walkable distance of 15 minutes. This was used to evaluate the city of Hassan in Karnataka, India. By employment of a conceptual radius of 400 meters the pedestrian shed was defined as a locality, in the overlaid model of the 15 min city for the context of Hassan. Seven such localities were defined to constitute a neighborhood. The 15 min city plan as defined by Carlos Moreno was overlaid on the existing plan of Hassan and analyzed with the assumption that the historical medium-sized city of Hassan may have an underlying structure of a walkable city, damaged by recent developments and an increase in population. Restoring and guiding the urban transformations in accordance with a clearly defined structure of neighborhood localities was proposed which enhanced the quality of life of the citizens. The proposed structure also defined the areas to locate the future proposed amenities at the neighborhood level.

Keywords: Neighborhood, walkable, amenities

Paper ID 147

Experimental Investigation on Influence of Natural Fibers on Strength Properties of Concrete

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Considering global warming issues in the environment, there has been a rapid growth in research and innovation in the natural fiber composite area. The natural fiber compo-sites have major advantages over the synthetic based fibers. Beside the low cost and the light weight, bio-based polymer composites (natural fibers) gained more attention due to their renewability and biodegradability. The natural strands, for example, coir, palm, kenaf, jute, sisal, banana, pine, sugarcane and bamboo and so on. The study investigates the various influence of natural fibers (jute and coir) on concrete by varying proportions by weight of cement. The experimental work on concrete were conducted by varying the mix proportions of fibers in concrete by weight of cement. The strength properties of concrete were performed and the results are tabulated. The strength results are compared with the conventional concrete and the results were tabulated. According to the work of researchers, the use of natural fibers as partial replacement in concrete or varying proportions by weight of cement has a distinct advantage over the synthetic fibers. Because of its beneficial effect, the natural fibers especially jute fiber can be used for any structural purpose.

Keywords: Natural fibers, Mechanical properties, compressive strength, split Tensile strength.

Paper ID 183

AHP Framework for Prioritising Risk Factors in Bridge Construction

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With increase in scale of road construction in India, It has become increasingly difficult to assess the timely completion of bridge construction. The major issue for delay is poor management of associated risks on projects. Moreover, the complexity of bridge projects further adds variety of risk factors. It is important to concentrate only on most significant risk factors which are having highest impact on timely completion of project. In this work author brought an AHP approach to identify most significant risk factors on bridge construction which are responsible for delay. Around 25 bridge case studies are considered for work. The long list of risk factors is formulated through repository of literature and bridge expert's opinions. In the framework initially risk factors are divided in 3 level hierarchy for eliciting weightages. Then, the matrix is prepared using the pairwise comparison and the final weightages are obtained through AHP procedure. These weights are further used for prioritisation of risk factors. The main intent of this work to produce robust framework in prioritisation of risk factors predicted in bridge construction.

Keywords: Bridge Construction, AHP, Prioritisation.

Paper ID 230

Techniques of Construction Delay Analysis – A Review

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Since the implications that delays have on both the schedule and the budget of building projects are one of the primary foci of research in the scientific community, numerous studies have been carried out by Scholars on the topic of delay analysis techniques. This is one of the most important fields of research focuses in the scientific community. As a result of the constructive contributions made by the researchers, it is thought that it is highly necessary to summarise all the delay analysis techniques and their preference for both future researchers and practitioners. In this light, the purpose of this research is to determine the techniques that have made the most important contributions to the development of the delay domain within the construction industry with regard to delay studies conducted all over the globe. As a result, 18 techniques to delay analyses were found using the Scopus Database and the Web of Science Database between the years 1985 and 2022, According to the findings of this review article, there is currently no Standard technique for evaluating delay claims. In addition, our attempt revealed that the Day-by-Day approach fulfils all of the necessary requirements, but the other strategies fall short in some areas.

Keywords: Delay, Construction, Analysis, Techniques

Paper ID 242

AHP Approach for Risk Factors Prioritisation in Tunnel Construction

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Tunnelling is amongst the most demanding infrastructure projects done in civil engineering industry. In addition to its severity of work, the construction being done in underground conditions makes it highly vulnerable to schedule delays, cost overruns etc., making risk analysis has been a very important aspect in tunnel construction. Due to its complexity the tunnelling industry each tunnelling project has numerous risk factors affecting the flow of construction work. The long list of factors is initially curtailed using Relative importance Index (RII) then these risk variables are further prioritized on the basis of the relative importance of expert opinion by using Analytic Hierarchy Process (AHP) approach. A literature analysis and real-life case studies in tunnel construction yielded 98 risk indicators. The list was then reduced to 75 by removing elements that were repetitive or overlapped. The remaining elements were grouped into clusters and rated using two methods: the Relative Importance Index and the Analytical Hierarchical Process. Tunnel projects are complicated and expensive infrastructure projects; hence the goal of this research is to improve current risk analysis practices by offering a more accurate framework for risk analysis and prioritization.

Keywords: multi-criteria-decision-making (MCDM), risk prioritization, tunnel projects

Paper ID 244

Identification and Prioritization of Risk Factors Impacting Cost Overrun in Indian Road Construction Projects

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In every construction project, risk is a very common event. Whereas it is more significant in road construction projects as it involves multiple activities in several stages and spread over a wider geographic area, therefore it may be unpredictable. Due to these risks, budgets are stretched excessively, which results in project cost overruns. The purpose of this research is to identify the risk variables that cause cost overruns in projects for developing roadways in India. Several risks are identified through the use of a comprehensive literature review and on-field expert advice. To get a construction professional's perspective on risk factors contributing to cost overruns, the questionnaire survey is developed. RII (Relative Importance Index) technique is used to prioritize risk factors from the pool causing cost overrun in road construction. By gathering all the responses from a questionnaire survey with experts working in road construction, this work attempts to find the most important risk factors for road construction and prioritize them accordingly. By identifying important risk factors in the early stages of the project, it would be possible to reduce complexity throughout the development of roads. It is expected that the framework will assist researchers and decision-makers in ranking the risk factors and focusing on the most critical ones to mitigate risks, prevent delays and cost escalations, ensuring the successful completion of road construction projects in India.

Keywords: RII (Relative Importance Index), Cost overrun, Road construction, Risk factors.

Paper ID 301

Feasibility of Iron Ore Tailings in Geopolymer Concrete for Sustainable Development

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Sustainable development is a crucial aspect of any industry, especially in developing countries where the management of solid waste is a significant challenge. The construction industry, which uses vast amounts of raw materials, is no exception. The introduction of geopolymer concrete (GPC) has paved the way for sustainable development in this sector. GPC replaces cement, a significant producer of CO2, with fly ash, an industrial waste product from thermal power plants. This process not only reduces waste but also significantly lowers CO2 emissions. While the use of fly ash in GPC has proven to be effective, there are limitations due to the need for steam or thermal curing to achieve sudden strength development. The incorporation of ground granulated blast furnace slag (GGBS), another industrial waste product from the metallurgy industry, has further improved the sustainability of GPC. This addition allows for ambient curing and strength development, reducing energy consumption and associated green-house gas emissions. Furthermore, the utilization of another waste material, such as iron ore tailings, as a replacement for fine aggregate in GPC production, demonstrates the potential for sustainable development. IOTs are a by-product of the iron ore beneficiation process and can effectively replace fine aggregate in GPC production. This approach reduces waste and creates a circular economy by repurposing a waste product. Thus, the introduction of GPC, the incorporation of industrial waste products, and the use of waste materials as replacements for traditional construction materials are all significant steps towards achieving sustain-able development in the construction industry, which is dealt in this paper especially with the feasibility of introduction of iron ore tailings into GPC.

Keywords: GPC, Fly ash, GGBS, Iron ore tailings, Sustainable development.

Paper ID 335

Interior Design App Using Augmented Reality

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People can now interact with both physical and virtual objects thanks to advancements in computer technology. An innovation known as Augmented reality (AR) coordinates computerized data with the client's environmental elements continuously. It overlays virtual articles like data and PC produced visuals over clients' view of the real world. The "Interior Designing App", an Android app with an augmented reality-based system that uses image-based tracking to position virtual objects on the real world, is our recommendation for this study. This system has been developed using UNITY 3D, VUFORIA, and BLENDER. Unity 3D has been used to create the AR application and design the functionalities in it. VUFORIA has been used to create and utilize the image targets inside the application. This has been achieved by linking the two portals and importing the necessary packages. Blender has been used to create the 3D models of objects that have been used in the application. Users can arrange objects and see how they will look in the real world with this software.

Keywords: AR, Image based tracking, Interior Designing

Paper ID 344

Investigate the Correlation Among Work Autonomy and fringe benefits towards job Satisfaction among Construction Professional in Chennai

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Job satisfaction is significant multifactor influencing workforce productivity. Job satisfaction is termed as positive emotional circumstances of an employee experience with particular job Particular analysis is accomplished to examine the effects of job satisfaction towards increasing professional employee's productivity levels in the construction industry and to determine factors correlated with productivity decrease among professional construction employees with special reference to various construction industry in Chennai. In this study, 500 respondents selected on various job levels in construction industry are participated. Data was collected using demographic questionnaire and job performance centric questionnaire as job descriptive index to investigate the job satisfaction level. Further questionnaire investigates effectiveness of the professional employee to increase the company productivity on managing the employee in the study. The job satisfaction level was considered as low, moderate and high respectively. Also, their productivity was computed as moderate. Furthermore, positive association among between job satisfaction and work productivity indices was considered as significant. The statistical analysis using SPSS software represents that productivity was significantly correlated with dimension of job satisfaction such as work autonomy and Fringe benefits.

Keywords: Job Satisfaction, Construction Productivity, Work Autonomy, Fringe Benefits

Paper ID 564

Finite element method for one – dimensional Darcy-Brinkman-Forchheimer fluid flow model

Anand N
Dr T Thimmaiah Institute of Technology

In this work, we consider an efficient finite element discretization of the fully nonlinear, one-dimensional Darcy-Brinkman-Forchheimer fluid model. We provide a competent Damped Newton's method type linearization coupled with Lagrange finite elements for the numerical solution of the model. The convergence rates for a manufactured solution is provided to show the efficacy of the proposed method. The overall method is very effective in handling the nonlinear differential equation.

Keywords: Darcy-Brinkman-Forchheimer equation, Finite element method, Linear shape functions, Newton's method, Direct method

Paper ID 604

A Conceptual Approach to Apply Agile Management in Construction

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The construction industry plays a huge role in the growth of the country and the construction project management will aid the construction in all the aspects from inception to completion of project, the project management is the systematic way of planning and organizing of the resources to accomplish a specific task, event or any activity. The project management is often associated with disciplines of information technology (IT) industry, manufacturing industry, healthcare industry and engineering and construction industry. As in the present time, we in the construction industry are using the traditional project management (TPM) system which in other words is also called as Waterfall method. All the other industries have the flexibility of applying this kind of project management system which is more dynamic and adaptive system. It is a bit more challenging in the construction industry to apply the APM since we don't have that flexible approach in the industry. In this paper work, an attempt is made to study the project management systems in brief and to understand the applicability of APM in construction industry by the semi structured interview of the questionnaire. In this study, the implementation of APM will be better when it is hybridized with the traditional project management system.

Keywords: Project Management (PM). Agile Project Management (APM), Applicability of APM in Construction Industry.

Paper ID 658

Mining and Mineral Industrial Water Reclamation a concise study in a Laboratory scale.

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The present work is aimed to recover the water from the iron ore processing plant refuse slurry generated during the beneficiation of the Iron ore. These tailings consist mainly of fine particles of less than 25 microns (Ultrafine particles) in the form of suspensions; discarding such slurry affects the overall water balance of the plant and increases freshwater consumption. Thus, dewatering the waste slurry is an essential part of iron ore processing activities. Recovery of water from such refuse slurry is studied by selective flocculation studies using suitable flocculants. The iron ore refuse slurry was collected from the input point of the tailing thickener of Acore Industries Pvt. Ltd., Sandur Karnataka. The test variables like., Pulp density 5-15%, Slurry pH 10-12, a flocculant (starch) dosage 50-150g/t were analyzed in detail and found nearly 90% of water shall be recovered if the slurry consisted of 5% solids, 12 pH and 150 gpt (grams per ton) of flocculants dosage. The studies carried out on the SI and WRI showed the highest WRI value of 96.9% at a feed concentration of 5% with a flocculants dose of 150 gpt and slurry pH of 11 where the concentration of the settled slurry was 60.87% solids.

Keywords: Selective flocculation, Flocculant, Settling index.

Paper ID 677

Temperature and soil parameter monitoring system

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In times of global food scarcity, every farmer aims to increase crop yield. This is made possible by monitoring the factors which affect it the most-temperature, humidity, and moisture content in the soil. Our project offers a unique solution to the challenges farmers and gardeners face in monitoring soil conditions that affect crop growth. The compact and weather-resistant design of the device makes it ideal for use in agricultural applications. Addition-ally, it has potential uses in smart home applications and environmental monitoring.

Keywords: Temperature and humidity monitoring, IoT, soil moisture monitoring

Paper ID 579

Evaluation of spatial variation for terrain parameters associated with surface and ground water quality necessary for sustainable geo-environmental condition.

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The soil and water conservation measures to be implemented for quality improvement needs to mainly consider the terrain issues, In the same manner the ground water resources from wells in the region has to be assessed for its quality so that its suitability for different needs could be ascertained. The inland salinity threats in the semi-arid tropics can get aggravated during extremities like droughts and low monsoonal rainfall. In this context the study of spatial variation of water quality can protect environmental geology and subsequent management of the geo-environment affected from various issues. The assessment regarding variation in ground water quality in spatial and temporal mode is required to suggest the line of treatment to the ground water for its suitability in various usages apart from making it potable. The geo environment as a sustainability parameter can be improved through investigation and prioritization of conservation measures and practices by use of temporal Remote sensing and other associated data to carry out evaluation of delineated watersheds in the area by Analytical Hierarchy Process Model approach required to prioritize the watershed leading to evolution of action plans for maintaining sustainable geo-environment. The details on the above issues are discussed in the paper.

Keywords: Conservation, water quality, Water Quality Index, Geo-environment. AHP model, Sustainability, Geo-environment

Paper ID 391

Strategies of Passive Design Buildings in Cold and Arid Climates: A Review

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Passive design strategies have gained increasing attention in recent years as a means of improving the energy efficiency and comfort of buildings. These strategies aim to reduce the energy consumption of buildings by utilizing natural resources such as sunlight, wind, and vegetation. This article provides a review of the literature on passive design strategies and their performance in buildings in cold and arid climate zones. Snow regions present unique challenges and opportunities for sustainable building design due to extreme cold temperatures, heavy snowfall and the need for effective insulation. The review emphasizes about implementation of passive design strategies, including site analysis, building orientation, insulation, snow management, and efficient heating systems. Passive design of buildings in arid climates focuses on utilizing natural elements and strategies to maximize energy efficiency and thermal comfort with8 out relying heavily on mechanical cooling systems.

Keywords: Temperature Control, Energy Efficiency, Passive Design.

Paper ID 461

Innovative Exploration Techniques: Utilizing IoT-Enabled Robots for Safe and Efficient Underground Tunnel Investigation

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The use of IoT-enabled robots in the investigation and maintenance of underground tunnels has gained significant attention in recent years. These robots, equipped with sensors and cameras, offer numerous advantages, including improved safety, increased efficiency, and cost reduction. This research explores the benefits of employing IoT-enabled robots for tunnel analysis and maintenance, while addressing the challenges associated with their implementation. The study focuses on the use of LIDAR technology for perception, mapping, and navigation of the robots in unstructured underground environments. The autonomous navigation system encompasses perception, map building, location calculation, planning, control, and obstacle avoidance. The research includes the development of customized software applications, integration of advanced sensor technologies, communication infrastructure, and experimental setups to simulate underground tunnel environments. Data collection, analysis, evaluation, and validation are conducted to assess the performance and effectiveness of the IoT-enabled robots. Additionally, the integration of IoT-enabled robots in civil engineering applications is discussed, including construction site monitoring, automated inspection and maintenance, smart infrastructure monitoring, autonomous construction and excavation, hazardous environment exploration, geotechnical monitoring, and disaster response and recovery. The results demonstrate the visualization of surrounding objects using LIDAR data and showcase point clouds captured in cave and tunnel environments. Overall, this research demonstrates the potential of IoT-enabled robots to revolutionize underground tunnel inspection and maintenance, offering improved safety, efficiency, and quality control in civil engineering projects.

Keywords: IoT-enabled robots, LIDAR, Autonomous systems, Safety, Efficiency.

Paper ID 521

Event-based Sensing for Improved Traffic Detection and Tracking in Intelligent Transport Systems towards Sustainable Mobility

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This paper presents a pipeline that utilizes a Torch Script model to implement event-based detection in challenging traffic scenarios, aligning with the theme of Advances in Intelligent Transport Systems (ITS) for Sustainable Mobility. The pipeline incorporates intuitive interfaces for visualizing event streams in both 2D and 3D, enhancing the understanding of traffic dynamics. It also integrates adaptive rate control and optical flow estimation techniques to improve detection and tracking capabilities. The model demonstrates promising results in accurately detecting and tracking vehicles and pedestrians. To validate the model's performance, we analyse the spatio-temporal distribution of events using histogram difference computation and exponential-decay time surface analysis, which provide valuable visual insights. By effectively utilizing event-based sensing and incorporating innovative techniques, this research contributes to the advancement of vision-based traffic monitoring for sustainable mobility within the field of Intelligent Transport Systems.

Keywords: Intelligent Transportation Systems, Vision-based Traffic Monitoring, Event-based Sensing, Traffic Detection, Vehicle Tracking, Sustainable Mobility, Sustainable Development.

Paper ID 637

Human Activity Recognition in Construction Industry Using Machine Learning Pose Estimation Technique

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In many applications, including measuring physical activity, understanding sign language, and controlling full-body gestures, human position estimation from video is essential. This has the potential to be utilized for activity recognition in civil work. By accurately tracking human body posture from video, the technology can identify and classify different tasks and actions being performed by workers in construction, manufacturing, or other industries. This information can be used to monitor worker productivity, optimize workflow, and identify potential safety hazards. The proposed project is a machine learning (ML) solution for high-fidelity body posture tracking, employing current open-source research that also drives the Machine Learning Pose Detection Application programming interface to infer predefined 3D landmarks and background segmentation mask on the entire body from RGB (Red, Green, Blue) video frames. The suggested method in this project achieves real-time performance on the majority of modern mobile phones, desktops/laptops, Python, and even the web, in contrast to current state-of-the-art methodologies, which rely mostly on strong desktop environments for inference.

Keywords: human activity recognition, virtual agent, pose Estimation.

Paper ID 638

Machine learning based intelligent Inventory system for construction Industry for Construction Industry

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Inventory management in the construction industry is a complex and time-consuming process that requires careful attention to detail to ensure materials and supplies are properly managed within budget and on schedule. Effective inventory management involves tracking, organizing, and optimizing construction equipment and supplies. Machine learning algorithms can play a significant role in enhancing inventory management in the construction industry. These algorithms can be used for demand forecasting, optimizing inventory levels, predicting maintenance needs, selecting suppliers, and generating reports. By analysing historical data on material usage and equipment expenses, machine learning algorithms can predict future demand, optimize inventory levels in real-time, anticipate equipment maintenance requirements, proactively schedule maintenance, identify reliable and cost-effective suppliers, and generate reports for inventory tracking. Implementing machine learning in inventory management can help construction companies reduce costs, improve operational efficiency, enhance cash flow, and streamline procurement processes.

Keywords: Inventory management, Construction industry, Demand forecasting, Optimization.

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